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AN ELEMENTARY INTRODUCTION TO THE KNOWLEDGE OF MINERALOGY:

INCLUDING SOME ACCOUNT
OF
MINERAL ELEMENTS AND CONSTITUENTS;
EXPLANATIONS OF TERMS IN COMMON USE;
BRIEF ACCOUNTS OF MINERALS,
AND OF THE PLACES AND CIRCUMSTANCES IN WHICH THEY ARE FOUND.

DESIGNED FOR THE USE OF THE STUDENT.

BY WILLIAM PHILLIPS,
MEMBER OF THE GEOLOGICAL SOCIETY.

With Notes and Additions on American Articles,

BY SAMUEL L. MITCHILL,
Professor of Mineralogy, Botany and Zoology, in the University of New-York;
President of the Lyceum of Natural History, &c.

Nullum est sine nomine saxum.—Lucan.

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P5

SOUTHERN DISTRICT OF NEW-YORK, ss.

BE IT REMEMBERED, That on the twenty-eighth day of May, in the forty-second year of the Independence of the United States of America, COLLINS & Co. of the said district, have deposited in this office, the title of a book, the right whereof they claim as proprietors, in the words and figures following, to wit:

" An Elementary Introduction to the knowledge of Mineralogy: including some account of Mineral Elements and Constituents; explanations of terms in common use; brief accounts of Minerals, and of the places and circumstances in which they are found. Designed for the use of the student. By WILLIAM PHILLIPS, Member of the Geological Society.—With notes and additions on American articles, by SAMUEL L. MITCHILL, Professor of Mineralogy, Botany and Zoology, in the University of New-York; President of the Lyceum of Natural History, &c."

" *Nullum est sine nomine saxum.*—Lucan."

In conformity to the act of the Congress of the United States, entitled " An act for the encouragement of learning by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the time therein mentioned." And also to an act, entitled " An act, supplementary to an act, entitled an act for the encouragement of learning, by securing the copies of maps, charts and books, to the authors and proprietors of such copies, during the times therein mentioned, and extending the benefits thereof to the arts of designing, engraving and etching historical and other prints."

JAMES DILL,
Clerk of the Southern District of New-York.

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PREFACE.

A considerable edition of the little volume entitled an 'Outline of Mineralogy and Geology' having been nearly, and very unexpectedly, exhausted, in the short space of a few months, it became a subject of consideration, whether it could be so enlarged as to render a second edition more interesting and valuable, without greatly increasing the size and price of the book. It occurred to me, that it might be possible further to illustrate the subjects on which it treats, by introducing some account of the more important minerals, with general observations upon such as should be omitted. But, when considerable progress had been made, it assumed such a patch-work character, that I resolved to re-publish the 'Outline,' with such alterations only as might seem essential to be made; more especially, as partial descriptions would completely alter its character, without fully answering the purpose of their introduction. Its object will therefore be, as before, rather to awaken inquiry, than to satisfy it.

The attempt to improve it, however, served to convince me, that, if descriptions, of individual minerals, together with some account of the places and circumstances in which they are commonly found, were collected with tolerable fidelity, from the best authorities, and comprized in a small volume, it would prove instructive to the young mineralogist; more especially, if divested of technical and scientific terms, as much as the nature of the subject will allow. This feeling was an incitement to undertake the labour of selecting, which, at best, is but an humble occupation.

It next became an object to determinate the order in which these descriptions should be placed: and when it is considered that any one of the several arrangements that have already been promulgated, might have been chosen, I can scarcely hope to escape censure for having adopted one, that, in some respects, differs from them all; my apology is, that not one of them was adapted to my purpose.

In the introduction to Aikin's 'Manual of Mineralogy,' an attentive perusal of which I wish again to recommend to the student, there are some excellent remarks on the prevailing arrangements of minerals. From all that has hitherto been done, it may be argued, that the very nature of the substances comprehended in those arrangements, forbids the construction of any one against which many well-founded objections cannot be raised; and wherein there shall not be much that is arbitrary, and consequently, dependent one some particular views, or some favorite theory. Hitherto, no natural classification of minerals has been discovered: either this most desirable object cannot be attained, or the science is not yet sufficiently understood to allow of its accomplishment.

It cannot, however, be denied, on the one hand, that the science of mineralogy is greatly dependent on that of chemistry; nor, on the other, that its acquirement should be regarded as preliminary to that of geology.—It therefore seemed indisputable, that if it were possible to exhibit the science in such a point of view, as that its dependence on the one, and its intimate connexion with the other, should become apparent, the result would be advantageous to the student.

With these objects principally in view, peculiar attention has not always been given to the enumeration of all the nicer characteristics of each mineral, nor to the maintaining of one exact order of description. This has been done by Aikin, in his 'Manual of Mineralogy,' with all the fidelity which a precise and scientific detail of these characters requires. It has rather been my intention to give, in familiar language, the more important mineralogical and geological characters of each, so as to enable the student, by such acquaintance as he may thus familiarly gain with the objects of his study, to consult with advantage the more scientific works of abler mineralogists. Consistently with this intention, explanations of about one hundred terms, commonly used in mineralogical description, are given at the end of the Introduction; which includes an enumeration of mineral elements and constituents, together with a brief view of their chemical characters, and remarks tending to shew their mineralogical and geological importance. The order in which the individual minerals have been described, and which is exhibited in the Table of Contents, was governed by an attention to the same objects.

Thus, siliceous minerals are first described, because it is estimated that silex forms the largest proportion of the oldest and most abundant primitive rocks: and all earthy minerals, of which silex is the largest ingredient, are arranged under that head; beginning, chemically, with silex in its purest form, and proceeding to such as consist of that and another earth, as silex and alumine, then to those consisting of silex and lime, &c. and afterwards, to such minerals as are chiefly constituted of three or more earths, terminating with the most compound; and regarding the iron, manganese, &c. involved in many of them, only as accessary constituents. The other earthy minerals are proceeded with in like manner, arbitrarily selecting such as contain the rare earth, glucine, and placing them under that head, except that the Gadolinite, which also contains the still more rare earth, Yttria, is placed under the latter. In regard to metalliferous minerals, the rules I had prescribed for the order of description, could not always be adhered to without involving some absurdity; for instance, in the ore called White Silver, that metal is an ingredient, according to one analysis by Klaproth, in the proportion only of about 2 per cent.; but it would have been altogether ridiculous to have placed a substance bearing the name of White Silver, among the ores of Lead, to which, according to the proportions of its ingredients, it properly belongs.

In order to avoid too greatly the appearance of a scientific work, every mineral has been described only under the name or names by which it is commonly distinguished in our own country. The synonyms may be found in Aikin's 'Manual,' and still more at large in the useful 'Mineralogical Nomenclature' of Allan.

This compilation, for it includes but little that is new, has been selected from the works of the most experienced mineralogists; chiefly from those of Haüy, Brongniart, Jameson, the Chemical and Mineralogical Dictionary of Aikins, and the Manual of Aikin; but, considering the purpose of the book, it seemed unnecessary to acknowledge the numerous quotations from those and other works in a more particular manner, by repeated reference to their pages.

It is common with the beginner to ask for some means by which he may be enabled at once to recognize any mineral that may present itself to his notice. To this inquiry, it may be replied, that, without the aid of study and experience, no means sufficiently precise can be hoped for in a science which is without a natural arrangement; and which therefore is divested of the certainties belonging to the study of the animal and vegetable kingdoms. A studious comparison of their characters, with the descriptions published in the works of mineralogists, might possibly enable the student to accomplish this desirable object. This method is undoubtedly tedious; and in most cases, the best rules that have been laid down, pre-suppose certain previous attainments; but the labour would be materially lessened, if the individual specimens were well characterized, and properly designated. The most effectual and advantageous method of acquiring a competent knowledge of minerals is undoubtedly that of personal instruction. The superiority which France and Germany have acquired in mineralogical science, is, doubtless, in a great measure, to be attributed to the facility of obtaining instruction, both public and private; of which there was an almost total deficiency in this country, until very lately. Each of our Universities has now its professor, and private instruction begins to be attainable. The metropolis and its neighbourhood are not without advantages in this respect. Lectures are given at the Royal and Surry Institutions. The time and attention of Mrs. Lowry, of Titchfield Street, whose fine collection of minerals, models, and instruments used in the mineralogical and geological researches, cannot fail, under her instruction, of being advantageous to her pupils, are occasionally given to this object: and T. Webster, of Buckingham Place, Fitzroy Square, who is draughtsman to the Geological Society, and has the immediate care of its valuable collection, and whose acquirements may thence be estimated, also dedicates a part of his time to instruction in the sciences of mineralogy and geology, as well as to the teaching of drawing; a knowledge of which is intimately connected with those sciences, and in the instruction of which he has adopted the most expeditious and advantageous methods he can devise.

Instruction in crystallography is also attainable. N. J. Larkin, of Gee Street, Somer's Town, who is a teacher of the mathematics, is in the habit of teaching their application to the theory of crystallization of Haüy. A perfect knowledge of this most beautiful theory can only be attained by a correct statement of the mathematical principles on which it is founded; nevertheless, the theory is also taught mechanically by N. J. Larkin, in a few lessons, by the assistance of models. These models cut in box-wood, may be had of Bate in the Poultry, and Mawe in the Strand, at one guinea each, as well as complete sets of models of all the crystals described by Haüy in his Treatise on Mineralogy, from eight pounds to sixteen pounds the set, according to the kind of wood of which they are made: they are cut by N. J. Larkin with great accuracy and beauty.

In the descriptions of individual minerals included in this volume, it was my wish to have given a somewhat detailed account of their crystalline forms. This I found to be impossible, without increasing the size of the book considerably. As, however, I conceive that it would materially tend to facilitate the progress of the young mineralogist, it is my intention, at some future time, to publish a view of the theory of crystallization, unless it shall be accomplished by some abler hand. This view will not be illustrated by the application of its mathematical principles, and will therefore be only mechanical; but it will necessarily be accompanied by numerous figures, illustrative of the theory, and of the transitions of crystalline forms.

It is probable that some who may look into this volume, may judge that if the descriptions had been more at length, more precise, and more technically scientific, they would have been more valuable, and consequently of more general interest. Such as may be induced to pass this judgment upon it, are entreated to advert to the main purpose of the publication. But, the simplicity of the design, and in all probability, the manner in which that design is executed, will deter the scientific from perusing a work which is manifestly intended only for the beginner—only as a first step for the student—and which, in reality, has little claim to the notice of the mineralogist.

W. P.

London, March, 1816.

PREFACE,

BY THE WRITER OF THE AMERICAN NOTES.

When the American Publishers first requested me to furnish additions to Mr. PHILLIP'S work, I hesitated about the undertaking. My doubt arose from the amount of information already extant in several valuable publications, upon Mineralogical subjects.

The MEDICAL REPOSITORY, from its commencement in 1798, to the present time, is replete with such intelligence. The second volume of that Journal, contains the circular address of the first Mineralogical Society *known in the United States*: an association, of which I had the honour to be the president, and with the honorable Samuel M. Hopkins, George J. Warner, Esq. and other early and zealous labourers, strove to arm every hand with a hammer, and every eye with a microscope.

WOODHOUSE'S EDITION OF CHAPTAL'S CHEMISTRY, contains many excellent observations, as it was published during 1807, and was considered by me as one of the best works of its time.

The AMERICAN MINERALOGICAL JOURNAL OF ARCHIBALD BRUCE, M. D. which was concluded in 1814, is an important collection of facts and observations, tending to elucidate the Mineralogy and Geology of the Fredonian States and Territories. But above all, Professor CLEAVELAND'S ELEMENTARY TREATISE, published in 1816, is so rich in domestic as well as foreign materials, and so generally and justly in the hands of students and other inquirers, that it seemed to supercede, in a great degree, the use of other books. It was notwithstanding, represented to me, that a more cheap, portable and compendious manual of the Science, was demanded, and that an impression of the present performance, would be immediately begun.

I therefore abandoned my scruplues, and determined to compose a few notes, for the purpose of giving more interest to the present edition. Where the matter of them has been borrowed, I have endeavoured to make proper acknowledgement of the source; believing, that for good deeds, every person ought to receive all the praise that is due to him. Wherever there may be omissions in this respect, the reader is assured they do not proceed from an intention to withhold commendation.

My own collection of facts and specimens would have permitted me to have been much more ample and diffuse. Indeed, it was a task of considerable difficulty, to restrict myself to the actual limits; there was nevertheless a reason for it. The description of many of the specimens in Geology, which my cabinet contains, having been already submitted to the public, there was less necessity to travel out of the province of Mineralogy on the present occasion.

I must however observe, that additional exertion, would have rendered this edition more complete, and that, from the rapid influx of materials, a future impression may be rendered incomparably more valuable.

It is very remarkable, how much I am indebted to *Ladies*, and to *Military Gentlemen*, for specimens. I hope their example will be followed by all other classes of Citizens.

SAMUEL L. MITCHILL.

New-York, May, 1818.

INTRODUCTION.

The investigation of the structure of the earth belongs to the science of Geology. It may however be interesting to take a rapid survey of the present state of our knowledge respecting it, were it only for the sake of showing its intimate connexion with mineralogical pursuits.

In speaking of the earth and of our knowledge of its structure, it is essential that the limited extent of that knowledge should always be had in remembrance. We are acquainted with it, only to a very inconsiderable depth; and when it is recollected that, in proportion to the bulk of the earth, its highest mountains are to be considered merely as the unimportant inequalities of its surface, and that our acquaintance does not extend in depth, more than one-fourth of the elevation of these mountains above its general level, we shall surely estimate our knowledge of the earth to be extremely superficial; that it extends only to its crust.

The term 'Crust of the Earth' therefore relates only to the comparative extent of our knowledge beneath its surface. It is not used with the intention of conveying an opinion that the earth consists only of this crust, or that its center is hollow; for of this we know nothing. The term may not be philosophical, but it is convenient.

The structure of the crust of the earth is most readily studied in mountains, because their masses are obvious; and also because, as they are the chief depositories of metalliferous ores, the operations of the miner tend greatly to facilitate their study. Mountains are composed of masses which have no particular or discernible shape: or, as is more commonly the case, of strata or beds, either horizontal or oblique, sometimes nearly vertical.

In these masses and beds, different structures have been observed. Some of them are crystalline; that is to say, are composed of crystals deposited in a confused manner, as in granite, or of crystals imbedded in some other substance, as in porphyry. These crystalline rocks contain no organic remains; and, as they are always found beneath, never above, those which do contain them, they are considered to have been of earlier formation, and therefore have been termed *primitive rocks.*

Other mountain rocks have no appearance of crystallization; but, on the contrary, seem rather to have been formed by the mere falling down, or settlement, of the substances of which they are composed, from the solution which contained them. These are always found above, never beneath, the crystalline rocks; and often contain a vast abundance of organic remains, both animal and vegetable. The more ancient of these, or such as contain the remains of animals of which the genera and species are extinct, are called *Transition rocks:* the more recent, or such as contain the remains of animals in some degree, or perfectly, resembling those inhabiting our oceans, are called *Flœtz* or *Flat* rocks, because their position is considerably, or perfectly, horizontal: the former have received the name of Transition, as connecting the primitive with the flœtz rocks. By many mineralogists the transition and the flœtz are classed together under the name of *secondary rocks.*

Primitive and secondary rocks have suffered considerable change and ruin from causes which it is not our present object to notice; and their disintegrated portions, having been formed anew, now constitute that peculiar description of deposite which is termed *alluvial,* and which therefore consists of the *debris* of other rocks. Such are clays, gravel, sand, &c. and these often contain the remains of land and amphibious animals, and of fish: they are found above the preceding, sometimes resting immediately upon primitive rocks.

But there is still another and a very different kind of rock, abundantly found in certain countries, which may in a great measure be considered, like the preceding, as resulting from the ruin of rocks, but from an opposite cause, or by an agent directly the reverse, viz. by fire; constituting those known by the name of *volcanic rocks*: many of these strongly bear the marks of heat, and even of ſusion; some, on the contrary, offer no evidence of their having been subjected to heat.

Lofty mountains composed of primitive rocks usually present rugged and uneven summits, and steep acclivities on the sides, as though they had suffered by convulsion. Such as are wholly or externally composed of secondary beds or strata, are less rugged on the summits and sides; their summits are flattish, or somewhat rounded, and their sides present acclivities more easily accessible; and are still more so when covered by alluvial matter, which serves to fill up their roughnesses and hollows, and often presents nearly a plane surface.

Both primitive and secondary mountains, more particularly the former, are traversed in various directions by fissures, of different dimensions. These fissures are not often empty, but are mostly filled with stoney or metalliferious substances, accompanied by vast quantities of water; but not often by portions of the rocks they traverse. These fissures are termed *Mineral Veins*: of whatever substance or substances, the body of a vein may be composed, its sides are commonly very determinate, and are by the miner called the walls of the vein.

From these veins, a large proportion of all the minerals which are found in the cabinet of the mineralogist, are extracted; indeed almost all such as, from their rarity, brilliancy, or peculiarity of form and combination, possess the greatest attraction for the mere collector: but these, though in these respects they may be the most curious, are by no means the most important.

Mineralogy is a science of so great interest, that it would be too much to be regretted were its real objects and tendency misunderstood, or suffered to degenerate into an avidity merely for the collecting of what is brilliant or rare. It is capable of affording larger and more useful attainment than the possession of an unique. To the attainment of the science of geology, that of mineralogy is essentially requisite.

The study of mineralogy, therefore, does not include only a knowledge of the more rare and curious substances; there is nothing in the mineral kingdom too elevated or too low for the attention of the mineralogist, from the substances composing the summits of the loftiest mountains, to the sand or gravel on which he treads. It is true that the aggregated masses of compound rocks are not arranged in a mineralogical collection; but it must be remembered that each of the substances of which such aggregated masses are constituted, are all comprehended in a mineralogical arrangement, and therefore find their places in the cabinet. Granite, it is true, is not to be found there; but its components, quartz, felspar, and mica, are met with in every one.

Thus, then, by the study of what, in opposition to the term aggregated rocks, may be termed simple minerals, the mineralogist becomes enabled to detect the substance with which he holds acquaintance by itself, when aggregated with others in a mass; and thus he becomes qualified for the more difficult and more important study of the science of geology; which embraces a knowledge of the nature and respective positions of the masses and beds composing mountains; and indeed of country of every description, whether mountainous or otherwise.

It is not, therefore, or at least it ought not to be, the sole object of the mineralogist, to be able to distinguish the several genera and species of mineral substances; nor should his attention be confined to the mere task of recognizing at first sight any mineral that may present itself, or of being capable of at once assigning it a proper place in his cabinet. He should hold a more enlarged acquaintance with minerals, and with the circumstances attending them, in what may be termed, their native places; he should know something of the positions they respectively bear towards each other in those places; he should become acquainted with their relative ages, deduced from the nature of the rocks in which they are found; their comparative scarcity or abundance; their combinations; the *countries* in which they occur; and their characters, both internal and external.

This knowledge, it may be repeated, is the first and requisite step to the science of geology: not that it is essential to this science that every mineral should be accurately known: some are of comparatively little importance in a geological point of view, from their extreme scarcity; but it is essential to become acquainted with simple minerals in the general, because of some of them, many of the vast masses of the earth are composed.

Minerals which are found only in primitive rocks, are said to belong to *primitive countries;* by which name are designed such tracts as are chiefly composed of primitive rocks. The substance in or on which a mineral is found, is called its *gangue* or *matrix;* when in its natural place or position, a mineral is said to be *in situ;* when this place and position are known, we are acquainted with its *habitat.*

In conformity with the object of this work, as explained in the preface, we must, before entering upon a description of individual minerals, take a view of the number, as well as of the nature of the elementary bodies, of which they are constituted. In this, I shall aim at brevity.

The whole number of mineral elements are commonly included in the list of 9 earths, 2 alkalies, 27 metals, and the two bases of combustible bodies, carbon and sulphur; but there are still other substances, both simple and compound, which having been detected by analysis, as entering into the composition of certain of the minerals about to be described; it seems essential in an elementary view of the science that these constituents should have a due consideration, whether they be regarded essentially as mineral elements, or only as accessaries.

These substances consist of certain acids, together with water, hydrogen and oxygen.

The acids are 13 in number, and are compound substances; generally, though not without exception, consisting of oxygen, united in different proportions with certain bases.

The base of the	Molybdic	*acid is*	Molybdena
	Arsenic		Arsenic
	Chromic		Chrome
	Tungstic		Tungsten
	Carobnic		Carbon
	Sulphuric		Sulphur
	Phosphoric		Phosphorus
	Fluoric		Fluorine
	Boracic		Boron
	Nitric		Nitrogen
	Muriatic		Chlorine
	Succinic		unknown
	Mellitic		unknown

most abundant of mineral elements, if not the most common and most abundant of all.

Of the most plentiful of all mineral substances, silex, it forms 54 per cent.; of alumine 46; of lime 28; of magnesia 38; of potash 17, and of soda 26 per cent.; to which it may be added, that it forms about 88¼ per cent. of water; and that in the ores of tin and manganese, and many of those of iron, lead, copper, &c. oxygen enters as an ingredient in various proportions.

Oxygen also forms an important ingredient in many minerals, as an essential element in certain acids; as in the two abundant substances the sulphate and carbonate of lime. It has been supposed that the latter alone constitutes one-eighth part of the whole crust of the globe. It may be assumed that lime stone is composed of 56 parts of lime and 44 of carbonic acid. Now lime consists of about 72 per cent. of calcium, and 28 of oxygen; and carbonic acid of about 28 per cent. of carbon, and 72 per cent. of oxygen; so that oxygen enters into the composition of the one eighth part of the crust of the globe, which is calculated to be constituted of carbonate of lime, in point of fact, nearly in the proportion of one-half.

But argillaceous rocks are considered to be more universal and plentiful than calcareous, and siliceous more abundant still. Of these rocks oxygen forms on an average 50 per cent.; so that the calculation in regard to the proportion in which oxygen enters into the composition of minerals, would amount to a very large percentage of the whole crust of the globe.

HYDROGEN.

The most simple form in which Hydrogen has been obtained, is that of a gas, in which it is in union with caloric, or the matter of heat. It is considered to be an elementary body.

Hydrogen is one of the component elements of water; its name is compounded of two Greek words, importing that circumstance; it is one of the elements of sulphur, and also, as it is believed, of phosphorus, of ammonia, and of the fluoric, and muriatic acids. It is obtained, in variaable proportion, from several of those substances, which are termed combustibles; and, in combination with sulphur, forming sulphuretted hydrogen, it has been detected by analysis, in the Haüyne or Latialite; the swinestone or stinkstone, a variety of carbonate of lime which is found in considerable abundance, is supposed to owe the peculiarly offensive odour which it gives out when scraped or rubbed, to the presence of sulphuretted hydrogen.

Hydrogen gas is emitted from the crevices of volcanic matter; and it is asserted by Brongniart, that near St. Barthelemi, which is not far from Grenoble in France, hydrogen gas issues from the crevices of a country which has no appearance of being volcanic; and consisting of a grey friable argillaceous schistus. The gas has no odour; and if inflamed continues burning sometimes for many months: the surrounding mountains are calcareous. He likewise says, that similar circumstances occur in England, on the road between Warrington and Chester, and also near Brozely in Shropshire.

WATER.

Water is composed of oxygen and hydrogen, in the proportion of about 88¾ of the former to 11¼ of the latter.

Water may be considered as merely an accessary, and not as an element, in some minerals: it is occasionally enclosed in crystal and chalcedony, and in variable proportion in certain minerals of a granular or loose texture; but, in some others, it is an essential principle, as is evinced by the difference existing between the forms of the primitive crystals of the common, and of the anhydrous, sulphate of lime; the latter of these is composed of lime and sulphuric acid; the former, of lime, sulphuric acid, and 21 per cent. of water: when water is an essential principle, it is termed *water of crystallization.*

Water is found in very different proportions, in a large number of earthy, as well as of metallic, minerals, both crystallized and massive.

The pure alkalies, potash and soda, retain even after fusion, about 1-5th of their weight of water; and all acids, in a liquid state, contain water as an essential element.

ACIDS.

It is impossible to give such a description of the acids as will characterize them altogether The greatest part of them are chemically described as possessing a sour taste of various degrees of intensity, and of reddening vegetable blue colours: but these properties are not common to all of them.

The peculiar properties of each acid are derived from the base. This base in most of the acids is united with a certain proportion of oxygen; which until lately was conceived to be the acidifying principle. In two of the acids it has however been proved, that their acidifying principle is hydrogen; which also is probably the case in respect of certain others.

The names given to the acids have been mostly derived from their bases: thus sulphur, in combination with a certain proportion of oxygen, affords sulphuric acid; carbon affords carbonic acid, and so on.

Acid.		*Base*		*Acidifying Principle.*
The carbonic,	*consists of*	carbon	*and*	oxygen
phosphoric		phosphorus		oxygen
fluoric		fluorine		hydrogen
sulphuric		sulphur		oxygen
muriatic		chlorine		hydrogen
nitric		nitrogen		oxygen
boracic		boron		oxygen
tungstic		tungsten		oxygen
chromic		chrome		oxygen
molybdic		molybdena		oxygen
arsenic		arsenic		oxygen
succinic		unknown		
mellitic		unknown		

Each of the above acids is found in one or other of the mineral substances about to be described; and in the preceding list they are arranged in the order of their supposed formation, arguing from the nature of the rocks in which the substances mineralized by them are met with.

An earth, a metal, or an alkali combined with an acid, is chemically termed a *Salt*; acidiferous mineral substances have therefore been termed *Salts*, by some mineralogists; and have been selected from minerals in general, and arranged under the name of *Saline Mine-*

rals. This selection has been altogether arbitrary; all those who have constructed arrangements have not been determined in their selection by a precise agreement in the characters of the minerals they have selected; the minerals of this class (for the existence of which there seems to be no reasonable occasion) have been much more numerous in some arrangements than in others.—By others the *Acidiferous Earthy Substances* have been placed by themselves under that title.

The carbonic, phosphoric, fluoric, sulphuric, muriatic, nitric, boracic, and arsenic acids, are found in combination with earths.

The carbonic, phosphoric, sulphuric, muriatic, tungstic, chromic, molybdic, and arsenic acids, are found mineralizing certain of the metals.

The nitric and carbonic acids are found united with potash.

The carbonic, sulphuric, muriatic, and boracic acids are found combined with soda.

PHOSPHORUS.

Phosphorus is a highly inflammable substance, usually of a flesh red colour, and very soft: its sp. gr. is 1.77.—In the atmosphere it emits a white smoke, and peculiar smell, and a faint and beautiful light arises from it.

When phosphorus is acted upon by a powerful voltaic battery, it gives out a gas in considerable quantity, which proves to be phosphoretted hydrogen: hence it is concluded that hydrogen is one of its component elements. This is the present extent of our knowledge respecting the nature of phosphorus.

100 parts of phosphoric acid are composed of phosphorus 36.72, and of oxygen 53.28. It is obtained by a chemical process from calcined bones; by another process, the phosphoric acid is robbed of its oxygen, and phosphorus is obtained.

Lead, manganese, and copper, are found mineralized by the phosphoric acid, in proportions differing from 18 to 31 per cent.; it also occurs in a small quantity in one of the ores of iron; and combined with lime, in the proportion of 46 per cent.

FLUORINE.

The last experiments of Sir H. Davy on fluoric acid, have induced him to believe that it is composed of hydrogen and a peculiar base which he has denominated fluorine. This substance, from its strong affinities and decomposing agencies, has not yet been exhibited in a separate state; nor have any attempts to detach it from its combinations been successful.

Lime, mineralized by the fluoric acid, is of abundant occurrence, forming fluate of lime, in which the acid exists in the proportion of 33 per cent; and it is combined in nearly the same proportion with alumine and soda in the cryolite; of the Saxon topaz and the picnite it forms 5 or 6 per cent.: it has not been detected in any metalliferous mineral.

NITROGEN.

Nitrogen, in combination with caloric, when it is termed nitrogen gas, is one of the constituents of atmospherical air: from its unfitness for the support of animal life, it is frequently called azotic gas: the term azote is compounded of two Greek words, having allusion to that negative quality. It has since been called Nitrogen gas, because, by a union with oxygen, it composes nitric acid.

It immediately extinguishes a lighted candle and even phosphorus, and is fatal to animal life.

It is suspected that nitrogen is not an element; Berzelius supposes it to be a compound of oxygen with some base in nearly equal proportions: this supposition is merely hypothetical.

The claims of nitrogen to be considered as a mineral constituent, are, that it enters into the composition of ammonia, one of the alkalies; and that, as a constituent of the nitric acid, which consists of 25½ of nitrogen and 74½ of oxygen, it is also an ingredient of nitre or saltpetre.

CHLORINE.

It is the opinion of Sir H. Davy, and many other able chemists, that the oxymuriatic acid contains no oxygen; the presence of which its name implies. He has consequently changed its name for that of Chlorine, derived from the green colour which it possesses when in a gaseous form. Chlorine has never been decomposed. The muriatic acid consists of equal volumes of Chlorine and hydrogen.

Chlorine has never been found pure, in nature.

The muriatic acid is found in small quantity in the sodalite, and one or two earthy minerals; but in common, or rock salt, it is combined in the proportion of 44 per cent.: it is found in combination with lead, quicksilver, and silver, in proportions differing from 8 to 21 per cent.: of the arseniate and phosphate of lead, it forms about 2 per cent.

BORON.

Boron is a peculiar combustible substance, which has been obtained by subjecting crystals of boracic acid to the action of a voltaic battery. Its precise nature is not yet understood; though it is ascertained to be a substance differing from every other known species of matter. Sir H. Davy conjectures that it is a compound.

Boracic acid is supposed to consist of one part by weight of boron, and 2 of oxygen.

The boracic acid enters into the composition of two rare earthy minerals, the boracite and the datholite: in the proportion of 83 per cent. in the former, and 24 per cent. in the latter. It has not been detected in any metalliferous substance; but it occurs in the proportion of 17 per cent. in the borate of soda, or borax, which is abundant in a certain lake in Thibet.

THE SUCCINIC ACID.

The only claim which the Succinic acid has to be considered as a mineral constituent, is, that it forms one of the ingredient principles of amber; which, though it be of uncertain origin, has by common consent obtained a place among mineral substances.

This acid is not obtained pure from amber; but when purified, it forms white, transparent, shining crystals, having the form of triangular prisms. The Succinic acid, from its property of decomposing all solutions of iron, is highly useful in the analysis of mineral waters. It has not been decomposed: its base is therefore unascertained.

THE MELLITIC ACID.

The Honeystone or Mellite, one of the combustibles, is the only substance that has yielded the Mellitic acid; which is obtained from it by a chemical process, in acicular crystals, which possess at once a sour, sweet, and bitter taste, and are combustible. The base of this acid is not ascertained.

Some account of the bases of the other acids will follow; carbon and sulphur being noticed under the head of Combustibles, and tungsten, chrome, molybdena, and arsenic, under that of Metals.

EARTHS.

The Earths are nine in number, viz.

Silex,
Alumine,
Lime,
Magnesia,
Zircon,
Glucine,
Yttria,
Barytes,
Strontian.

Four of them, Lime, Magnesia, Barytes and Strontian, possess some of the chemical characters of the Alkalies; by some, they have therefore been placed among the Alkalies; others have called them *Alkaline Earths.* The whole number were, until within the last few years, considered to be simple or elementary bodies, but Sir H. Davy has proved them to be compounds consisting of oxygen united with certain bases, some of which possess several of the characters peculiar to the metals; but the nature of these bases is not so well ascertained as that of the bases of the two Alkalies. The discoverer, however, considers most of them to be metals; and if this be admitted, the earths are to be considered as metallic oxides.

The four alkaline earths were much more readily decomposed, and their bases are ascertained to possess certain of the characters and properties of the metals, with greater certainty than the remaining five; which have a much stronger affinity for the oxygen with which they are combined.

The metallic basis of Barytes, has been named *Barium*, by Sir H. Davy; that of Strontian, he denominates *Strontium*; that of Lime, *Calcium;* for that of Magnesia, *Magnesium* has been proposed, but it is less perfectly known than the three preceding: the base of Silex, *Silicium*, has not been obtained in a state of separation; it was at first considered to be a metal, but "Sir H. Davy now believes it not to be a metal, but a substance most resembling boron; and, like it, bearing an analogy to charcoal, sulphur, and phosphorus." The base of Alumine, *Alumium*, has not yet been produced in a state fit for investigation: that of Zircon, or *Zirconium*, is still unknown: as well as that of Glucine, or *Glucinum*; and that of Yttria, *Yttrium*, has not been exhibited in a separate form.

These bases are united with oxygen in different proportions. That of Barytes is united with about 10 per cent. of oxygen; that of Yttria about 12 per cent.; of Strontian about 14 per cent.; that of Zircon 17 per cent.; of Lime 28 per cent.; of Glucine 30 per cent.; of Magnesia 38; of Alumine 46; and of Silex 54 per cent.

The Earths are here placed in the foregoing order, (p. xiv.) and the minerals of which they constitute the chief ingredients, will hereafter be noticed in that order, for the following reasons. Silex, Alumine, and Lime, are the principle constituents of the oldest primitive rocks. Magnesia also enters into the composition of a primitive rock, though not one of the most abundant. Zircon and Glucine are in part the constituents of a few rare minerals which are imbedded in early rocks, or are met with in the veins of primitive mountains; in the veins of which, also, Yttria, Barytes, and Strontian occasionally occur.

Some further observations respecting the relative proportions and localities of the Earths may prove interesting.

Silex is not only the chief ingredient of a large number of the most abundant rocks, but it also forms a considerable proportion of all clays and soils; it is the principal constituent of more than half of the whole number of compound earthy substances, which, in contradistinction to aggregated rocks, are sometimes termed simple minerals; it enters into the composition of a few rare and crystallized metalliferous minerals in the proportion of 30 or 40 per cent., and in very small proportion in several of the most abundant ores of iron. If therefore it were possible, as heretofore, to regard Silex as a simple elementary body, we should have no difficulty in adjudging it to be the most abundant in nature.

Alumine is considered to be the most plentiful earth after Silex. It occurs largely in primitive rocks, in many of the secondary, and in all clays and soils: it enters into the composition of a considerable number of earthy minerals, and in small proportions in a few metalliferous minerals, particularly in certain ores of iron.

Lime is less abundant than Alumine in primitive rocks; but is extremely so in transition and flœtz, or secondary rocks; it enters into the composition of many compound earthy minerals: it forms from 9 to 25 per cent. in a few rare and crystallized minerals, and is found in smaller proportions in a few others.

Magnesia is not an abundant ingredient in rocks; but is chiefly confined to those called serpentine, basalt, and certain varieties of limestone. Some of the earthy minerals in which it is found, and which are pretty numerous, occasionally enter into the composition of rocks, but are principally met with in veins. It occurs but sparingly in soils, and is unfavorable to vegetation: the only metalliferous mineral in which it has been detected is spathos iron, of which it forms less than 1 per cent.

Zircon, *Glucine* and *Yttria* are very sparingly found: the first is the most common; the second has been detected only as a component of a very few rare minerals in small proportions: both are met with imbedded, and in veins, in primitive rocks. Yttria has been discovered only as an ingredient in two or three rare minerals.

Barytes is not very abundant; *Strontian* may be esteemed a rare earth; they are chiefly found in mineral veins, and have not been detected in rocks or soils: they are principally met with in that state, which has induced some mineralogists to rank them among saline minerals. The latter has not been found combined in any metalliferous mineral; the former only in one, compact manganese, in the proportion of 14 per cent.

Silex, Alumine and Magnesia are met with nearly pure.

Silex, Zircon, Glucine and Yttria have not been found combined with an acid; but the former is involved in many acidiferous minerals.

Lime, Barytes and Strontian chiefly occur combined with acids; but the former is an ingredient in many earthy minerals which are not acidiferous.

THE ALKALIES.

The *Alkalies*, Potash, Soda, and Ammonia, have peculiar chemical properties, which are not our present object. The two first, not being volatilized by a moderate heat, are termed fixed alkalies; the last, as it exists in its purest form in the state of gas, is called Volatile Alkali. Potash and Soda were long considered to be simple elementary bodies, though it was also conjectured that they were not. Within the last few years that conjecture has been verified by the brilliant discoveries of Sir H. Davy, who effected their decomposition by means of electric or galvanic agency It has by this means been satisfactorily determined that Potash consists of oxygen, united with a base which, in many, if not in most respects, bears a strong affinity to the metals: it is of a silvery whiteness, and is solid at common temperatures. Soda, it has been determined, consists of oxygen united with a base which is solid at the usual temperature of the air.

These bases, *Potassium* and *Sodium*, are combustible bodies: by exposure to oxygen, under certain circumstances, they absorb it, and thus become alkalies again. In lustre, opacity and malleability, and in certain chemical properties, these bases agree with the metals: and have therefore been considered as metals by Sir H. Davy: but they are lighter than water, and are therefore at least six times lighter than the lightest of the metals, tellurium.

Potash consists of about 17 of oxygen, and 83 of potassium. Soda of about 26 of oxygen, and 74 of sodium.

Ammonia, or Volatile Alkali, has likewise been decomposed by voltaic electricity. 100 measures of Ammonia are estimated to consist of about 75 of hydrogen and 25 of nitrogen; but certain experiments, conducted by Sir H. Davy, have induced him to suspect that Ammonia contains 7 or 8 per cent. of oxygen.

Potash is found entering into the composition in about 15 earthy compounds, but not in any of the metalliferous ores: in small proportions it occurs in mica and felspar, two ingredients of the oldest rocks, and also combined with certain acids.

Soda is found in combination in about twelve earthy substances in variable proportion; but not in metalliferous ores: it occurs abundantly, combined with several of the acids.

Ammonia is met with only in combination with two or three of the acids.

METALS.

A metal may be *chemically* described as *a combustible or oxidable substance; capable, when in a state of oxide, of uniting with acids, and of forming with them compound salts.* This is a character applicable to all the metals and to no other class of bodies.

Metals are believed to be simple substances; not one of them having hitherto been decomposed.

In weight the metals far exceed the earths; the heaviest of the earths is only five times heavier than water, but the lightest of the metals is more than six times heavier than water. Beaten gold is nineteen times heavier than water, and beaten platina, the heaviest of all, is twenty-three times heavier than water.

The metals also have other important characters.—Each possesses a colour peculiar to itself. Some of them are exceedingly ductile, as is manifested by the extremely fine wires into which they are drawn. Most of them are good conductors of electricity; that they are also good conductors of heat or caloric, is evinced by the readiness with which heat is transmitted along a bar of metal, when one end is placed in the fire. They mostly possess elasticity and flexibility. Many of them have a peculiar taste and smell, both of which are disagreeable.

If when in a state of fusion, they are left to cool slowly and quietly, all the metals crystalize; and most of them in that case assume the form of the octohedron; which also is the form assumed by most of those which are found crystallized in the pure or native state.

The characters of fusibility and extensibility in metals is of vast importance to man; for without them neither could they be freed from the earths and other impurities with which they are naturally united, nor wrought into vessels for his use.

The only metals known to the ancients, were gold, silver, copper, iron, tin, lead and mercury; but discoveries have from time to time increased the catalogue, until it has been swelled to the number of twenty-seven, independently of those which have very lately been discovered as the bases of some of the earths and the two alkalies.

Of these twenty-seven metals, eleven only have the important property of malleability, or of being sufficiently tenacious to bear the extension of their body by beating with the hammer; the others have by some, therefore, been termed brittle metals.

Malleable Metals.

Platina
Gold
Silver
Mercury
Lead
Copper
Tin
Iron
Zinc
Palladium
Nickel

Brittle Metals.

Arsenic
Antimony
Bismuth
Cobalt
Manganese
Tellurium
Titanium
Tantalium

Molybdena
Tungsten
Chrome
Osmium
Iridium
Rhodium
Uranium
Cerium

A lustre is peculiar to the metals, which therefore is called the metallic lustre: another remarkable property is their want of transparency when in the mass; but as leaf gold held between the eye and a luminous body transmits a green light, and silver a white light, it seems probable that other metals, if attenuated in the same degree, would also be translucent.

The only metals that as yet have been found in the metallic state, are platina, gold, silver, quicksilver, copper, antimony, palladium, arsenic, tellurium, bismuth and iron; these are then termed *native metals.* But the greater part of these are rarely found quite pure, but mostly involve small proportions of other metals.

A *metalliferous ore* is a compound of two or more metals, as silver amalgam; or of a *metal in combination with oxygen,* as ruby copper, (whence such a combination has obtained the name of a *metallic oxide ;)* or a metal (in the state of an oxide) combined with an *acid,* as the arseniate of copper; or a metal combined with a *combustible,* as sulphuretted silver. Many ores are of so compound a nature as to consist of two or three metals united with oxygen, sulphur, one or more of the earths, and with water.

When a metal is combined with one or more substances, either combustible or saline, it is then said to be *mineralized.* Thus lead is said to be mineralized by sulphur when combined with it in the native sulphuret or galena. The sulphur is the *mineralizer.*

It deserves notice that seven of the *malleable* metals, zinc, tin, lead, iron, copper, nickel, and quicksilver, absorb oxygen from the common air, becoming at least externally oxidated: none of them part with the oxygen by simple exposure to heat, except quicksilver. Gold, silver and platina only become oxidated by exposure to the action of certain acids. But although the greater part of the malleable metals are readily oxidable, not one of them has yet been found in, or converted into, the state of an acid.

All the brittle metals absorb oxygen by exposure to common air, and thus become, at least externally, oxidated. Four of them, arsenic, chrome, molybdena and tungsten, by an excess of oxidation, pass into the state of acids, and in this state they are found to be the *mineralizers* of several of the earths and of the metals.

The metals and metalliferous ores are chiefly found in veins, of which they occasionally compose the only substance; but they are more often disseminated in veins, through earthy or stony substances: such a substance is thence termed the *gangue* or *matrix* of the mineral. Metalliferous ores are less commonlly found in masses or in beds: a few of them occasionally occur imbedded in certain rocks.

They are met with in veins traversing almost every kind of rock, but are more common in primitive and transition rocks, than in flœtz rocks: they occur but sparingly in alluvial deposites, and more rare in volcanic matter.

The comparative age of the metals is chiefly judged of by the nature of the rocks which enclose them. Iron and manganese have been detected by every analysis in mica, a constituent of the oldest primitive rock, granite; tin and molybdena occasionally occur imbedded in it; they also, as well as tungsten, titanium, cerium, uranium, chrome, and bismuth, are found almost exclusively in such veins as traverse the oldest of the primitive rocks; the foregoing metals may therefore be considered of the earliest formation. Arsenic, cobalt, silver, nickel, and copper, are presumed to be less ancient, because though they occur in the oldest primitive rocks, they are also found in newer. Gold, tellurium, and antimony, are considered to be metals of a middle age, as they occur in the newer primitive and the older secondary rocks. Lead, zinc, and mercury, are found in the greatest quantity in secondary formations, and are therefore supposed to be less ancient than the preceding. Platina, palladium, rhodium, iridium, and osmium, having never been found *in situ*, it is impossible properly to judge of their relative age; but as crude platina ininvolves small portions of palladium, rhodium, iridium, and osmium, as well as of copper, gold, and lead, we may conceive them to be of a middle age, and shall therefore in the following series, place them next to gold. In respect of age, therefore, the metals may be ranked as follows, and we shall accordingly, begin the description of metalliferous ores with the important ores of iron:

Iron
Manganese
Molybdena
Tin
Tungsten
Titanium
Cerium
Uranium
Tantalium
Chrome
Bismuth
Arsenic
Cobalt
Nickel
Silver
Copper
Gold
Platina
Rhodium
Osmium
Iridium
Palladium
Tellurium
Antimony
Lead
Zinc
Mercury

Iron is an ingredient in almost every rock, from the oldest primitive to the newest alluvial; and also in very many earthy and metalliferious minerals, and in all soils: it is therefore considered to be the most abundant and most generally diffused of all the metals. Wherever found, and with whatever combined, it is mostly in the state of an oxide, except when combined with sulphur.

Manganese, with iron, is an ingredient of mica, which is a constituent of the oldest granite; it occurs both in the primitive and secondary countries.

Molybdena may be reckoned a rare metal: it is occasionally found imbedded in granite, or in veins passing through it. It occurs only in the state of an acid or an oxide, or mineralized by sulphur.

Tin is abundantly and almost exclusively found in veins passing through primitive rocks, chiefly in granite and argillaceous schistus. Tin is always in the state of an oxide: it occurs only in one compound metalliferous ore.

Tungsten is by no means a plentiful metal, it usually accompanies tin: it occurs only as an acid combined with iron, or as an oxide combined with lime, in veins in primitive mountains.

Titanium occurs chiefly in the state of an oxide, and may be reckoned a rare metal: it is usually combined with iron, sometimes with silex.

Cerium is an extremely rare metal.

Uranium is also rare: it occurs chiefly in the state of an oxide in primitive veins.

Tantalium is still more rare: it occurs in the state of an oxide; in one of its ores it is combined with iron, in the other with the rare earth Yttria.

Chrome is a scarce metal, and occurs only in the state of an acid, mineralizing lead and iron.

Bismuth is not a common metal; it occurs in the native state, also mineralized by sulphur, and combined in some of the ores of silver, and of cobalt.

The preceding metals, being chiefly found in the oldest primitive rocks, are considered to be of the earliest formation; the succeeding five are supposed to be less ancient, because they occur both in the oldest primitive and in certain of the secondary rocks.

Arsenic is a more abundant metal than most of the preceding: it is involved in small portions in several of the native metals, in all the ores of cobalt, and in most of those of silver.

Cobalt is not found alloying any metal; in its ores it is combined with iron and arsenic; it is not plentiful.

Nickel is a rare metal: it occurs as an oxide, and also combined with arsenic.

Silver is a somewhat abundant metal; and it occurs in greater or less quantity in most mineral countries: in the native state, it occurs in veins and beds, and disseminated in rocks: its ores are numerous; it occurs combined with lead, copper, iron, antimony, tellurium, gold, quicksilver, and arsenic, and mineralized sulphur, and by certain acids.

Copper is an abundant metal; it occurs in the native state: its ores are numerous, and in them copper is combined with iron, sulphur, silex, oxygen, and certain acids: it occurs in most mineral countries.

The three following metals are found in the newer primitive and older secondary rocks, and therefore are metals of a middle age.

Gold, though less abundant than silver, is more so than most of the preceding, and is not to be esteemed a rare metal; though occasionally met with in veins, it is chiefly found in rivers and alluvial deposites: it occurs from 1 to 26 per cent. in the ores of tellurium, and sometimes in small portions alloying the native metals, copper, antimony, platina, and arsenic.

Tellurium is a rare metal: it occurs in the native state, but mostly is alloyed by a little gold: in its ores it is combined with gold, silver, lead, copper and sulphur: it has only been found in two or three places.

Platina is not a plentiful metal: it is found only in certain districts in America, and only in the native state; alloyed by small portions of gold, lead, copper, iron, osmium, iridium, and rhodium.

Palladium is rare; it is found with platina, in the native state, alloyed by small portions of platina and iridium.

Iridium and Osmium are also found accompanying platina, together forming an alloy; they also alloy platina, and the former of them, palladium: they are both rare.

Rhodium is found only alloying the platina of Peru, and is therefore extremly rare.

Antimony is not a very rare metal: it occurs in the native state, alloyed by small portions of iron and silver: in its ores it is combined with sulphur, silex and oxygen: it occurs in few mineral districts.

Lead may be considered as the most abundant and most universally diffused metal after iron: it never is found in the native state, but its ores are very numerous: it occurs abundantly mineralized by sulphur, and by certain acids; and is found in the state of an oxide: it occurs in certain ores of tellurium.

Zinc is not a scarce metal, but is pretty generally diffused: in its ores, it occurs combined with sulphur, iron, and silex.

Mercury is found only in a few places, but is not scarce: it occurs native and is combined with silver, sulphur, and with certain acids.

COMBUSTIBLES.

Combustibles form, in the mineral kingdom, a class of substances, having peculiar properties, and by no means agreeing amongst themselves in internal or external characters, and differing essentially from the earths, the alkalies, and the metals. Combustibles include both the hardest and the softest of mineral substances.

Several of the combustibles are found in a liquid state, some of these are translucent and even transparent; but the greater number are solid; when solid they are easily broken; they possess neither the opacity, brilliancy, nor the weight of metals, being rarely more than twice the weight of water; some of them are lighter than water.

If we were to class among combustibles, all those bodies whose chemical characteristic is that they will endure combustion, we should err, because many of the metals have that character.

Most of the metals whose properties are altered by combustion, acquire an increase of weight thereby; whereas combustible substances are sensibly diminished in weight by the same process. The product of some of them is liquid, of others solid; if solid, it is insoluble in water. Combustibles are either simple or compound.

The mineral bases of combustible substances may be said to be only two, viz. carbon and sulphur.

The purest form in which *Carbon* is seen, is that of the diamond; and it was for a long time considered that the only chemical difference between this gem and charcoal is, that the latter contains some oxygen, and therefore is an oxide of carbon. But the late experiments of several chemists, and particularly of Sir H. Davy, tend to show that there is no oxygen in pure charcoal; and that there is no decided chemical difference between it and the diamond. Charcoal, however, always contains either hydrogen or water in very small and variable proportions, but not as an essential ingredient: the diamond is absolutely free from hydrogen and water; and it is in this respect only, and in the mechanical arrangement of its particles, that there is any evidence of its differing from charcoal. The experiments of Allen and Pepys tend to prove that the actual quantity of carbon, in equal weights of diamond and charcoal, is precisely the same.

Carbon forms the basis of several of the combustibles, as coal, bitumen, amber, &c.; and it enters into the composition of a few minerals in small proportion: in the Aberthaw limestone, the hepatite, semi-opal and in clay slate, not exceeding 1 or 2 per cent.; in rotten stone 10 per cent.; and less than 1 per cent in compact manganese: its most important mineral character is, that it forms the base of the carbonic acid, which enters into all limestone rocks, as an ingredient, in the proportion of about 44 per cent.: carbonic acid consists of about 28 per cent of carbon and 72 of oxygen.

Sulphur was suspected by Berthollet to contain hydrogen, and this suspicion has since been confirmed by Sir H. Davy during the career of his brilliant discoveries, by means of the application of the astonishing powers of galvanism or electricity to many bodies which heretofore were considered to be simple or elementary. Some experiments of the same able chemist, tended to evince the presence of oxygen as another ingredient of sulphur: but the later experiments by Guy Lussac have proved that oxygen does not enter into its composition.

Sulphur is not only itself a highly inflammable body, but is also an ingredient of other combustibles; as of certain kinds of coal. Large deposites of sulphur are met with in some volcanic countries: it is found in considerable masses or in beds, both in primitive and transition countries; and it is largely involved in certain minerals; such as iron, copper, lead, antimony, silver, &c. which thence are termed sulphurets of those metals, and which, generally speaking, are the most abundant of all metalliferous ores; and it is met with in one earthy mineral, the Fahlunite, in the proportion of 17 per cent. Sulphur is the base of the sulphuric acid; which consists of 40 per cent. of sulphur and 60 of oxygen. The sulphuric acid enters largely into the composition of that abundant substance, sulphate of lime or gypsum; and is likewise an ingredient of several other earthy minerals; and in certain metallic ores.

EXPLANATIONS OF TERMS

Commonly used in Mineralogical Description.

Acicular. Long, ſlender, and ſtraight priſms, or cryſtals, are termed acicular, from the latin, acicula, a little needle.

Aggregated. A mineral or rock is ſaid to be aggregated, when the ſeveral component parts only adhere together, and may be ſeparated by mechanical means: the felſpar, quartz, and mica, conſtituting granite, may be ſeparated mechanically. Granite is an aggregated rock.

Alliaceous. The odour given out by arſenical minerals, when expoſed to the blowpipe or ſtruck by the hammer, reſembles that of garlic; in latin, allium, whence alliaceous.

Amorphous. Without form; of undefinable ſhape; from the Greek, αμορφος (amorphos) having that ſignification. Amorphous minerals are ſometimes deſcribed as being of indeterminate, or indefinite forms.

Anhydrous, from the Greek ανυδρος (anudros), ſignifying without water: anhydrous gypſum is without water.

Arborescent. From the Latin, arboresco, to 'grow like a tree: ſee Dendritic.

Botryoidal. From the Greek, βοτρυωδης (botruodes) ſignifying, hung with cluſters of grapes or berries. So a mineral preſenting an aggregation of large ſections of numerous ſmall globes, is termed botryoidal; but when the globes are larger, and the portions are leſs and ſeparate, the appearance is expreſſed by the term mamillated. Theſe forms may be obſerved in certain ores of cobalt, copper, and manganeſe, and often in chalcedony.

Bladed. This term relates chiefly to the ſtructure of ſuch minerals as, on being broken, preſent long flat portions, ſomewhat reſembling the blade of a knife; this appearance may in general be conſidered as the effect of interrupted cryſtallization.

Brittle. This character of mineral bodies does not depend upon their hardneſs; thoſe of which the particles cohere in the higheſt degree, and are immovable one among another, are the moſt brittle. The diamond, quartz, ſulphate of barytes and ſulphur, vary greatly as to hardneſs; they are all brittle.

Canaliculated: preſenting deep channels on the ſurface, reſulting either from interrupted cryſtallization, or the aggregation of numerous cryſtals.

Capillary, is derived from the Latin, capillus, a hair, and is chiefly uſed to expreſs the long, tortuous, hair-like appearances, to be obſerved in native gold and ſilver, and ſome other minerals. Cryſtals are ſometimes termed capillary, when long and ſlender; but being moſtly ſtraight, they are more properly deſignated by the term acicular.

Cavernous. A mineral in which there are conſiderable hollows or cavities, is ſaid to be cavernous.

Cellular. This term is uſed by Werner in the deſcription of ſuch minerals as exhibit cells formed by the croſſing and interſecting of the laminæ or lamellæ of which they are conſtituted: commonly, any mineral preſenting numerous ſmall cells or cavities, is termed cellular; ſee veſicular.

Chatoyant, has been adopted from the French, who uſe it to expreſs the changeable light reſembling that to be obſerved in the eye of a cat, to be ſeen in certain minerals; as in the Cat's eye.

Cleavage. This term is moſt commonly uſed in relation to the fracture of thoſe minerals which, having natural joints, poſſeſs a regular ſtructure and may be cleaved into geometrical fragments; as into varieties of the parallelopiped, the rhomboid, &c.

Coherent. This term relates to ſtructure. In minerals that are brittle, the particles are ſtrongly coherent; in ſuch as are friable, they are ſlightly coherent.

Columnar distinct concretions, is commonly uſed to expreſs the great and ſmall columns in which certain baſalts and iron ores are found: but Werner includes under this term all the columnar appearances in every mineral conſiſting of numerous aggregated cryſtals, which readily divide into long and narrow portions of irregular form, owing to interrupted cryſtallization—ſuch as the amethyſt, pyrites, fluor ſpar, quartz, &c.

Compact, is a term which relates wholly to ſtructure; and is that in which no particular or diſtinct parts are diſcernible; a compact mineral cannot be cleaved or divided into regular or parallel portions. The term compact is too often confounded with the term maſſive.

Conchoidal, relates only to fracture; and is doubtleſs derived from the Latin, chonchoides, ſignifying like the ſhell of a fiſh. Fragments of many of the brittle minerals exhibit this appearance, and occaſionally in great perfection, as quartz and ſulphur; the fracture of compact minerals is frequently more or leſs perfectly chonchoidal.

Concretion, generally ſignifies a ſmall and diſtinct maſs.

Coralloidal, reſembling branches of coral.

Cuneiform, wedge ſhaped; cuneus, in Latin, ſignifies a wedge. This term relates only to fracture.

Decompoſed. This term, when uſed ſtrictly in a mineralogical ſenſe, imports the decompoſition which takes place naturally in any ſubſtance. Certain ores of Iron, &c. in which ſulphur predominates in an unuſual degree, decompoſe by expoſure to air.

Decrepitate. A mineral is ſaid to decrepitate on expoſure to heat, when it flies with a crackling noiſe ſimilar to that made by ſalt when thrown into the fire.

Dendritic; derived from the Greek, δενδριτις (dendritis) ſignifying, like the growth of a tree. The terms arboreſcent and dendritic are uſed ſynonymouſly; they are alike applied to the tree-like appearance in which native ſilver and native copper are ſometimes found; to the delineations ſeen on the ſurfaces of certain minerals; and to the appearance in the mocha-ſtone, &c.

Dentiform, or *Dentated*; in the ſhape of teeth; dens being the Latin for a tooth.

Diſſeminated. When a mineral, whether cryſtallized or otherwiſe, is found here and there imbedded in a maſs of another ſubſtance, it is ſaid to be diſſeminated in the maſs. Cryſtals of quartz ſometimes occur, diſſeminated in Carrara marble, &c.

Diſintegrated. This term is generally uſed to expreſs the falling to pieces of any mineral, without any perceptible chemical action.

Diverging, or *Divergent*; relates to the ſtructure of a mineral. When the ſtructure is fibrous, and the fibres are not parallel, they uſually diverge in part, but not wholly, around a common centre; as in certain zeolites, and hæmatites iron ores.

Druſy, has been adopted from the German term druſen, for which we have no Engliſh word. The ſurface of a mineral is ſaid to be druſy when compoſed of very ſmall prominent cryſtals, nearly equal to each other; it is often ſeen in iron pyrites.

Elaſtic. A mineral which, after being bent, ſprings back to its original form, is elaſtic. Mica is elaſtic; talc, which greatly reſembles mica, is only flexible.

Earthy. This term relates to ſtructure. Chalk and certain of the ores of iron and lead are notable inſtances of it.

Faſciculated. When a number of minute fibres or acicular cryſtals occur in ſmall aggregations or bundles, they are ſaid to be faſciculated; a term doubtleſs derived from the Latin, faſcis, a bundle. This appearance often occurs in green carbonate and arſeniate of copper.

Fibrous. This term relates both to form and ſtructure. Certain minerals, as amianthus, amianthiform arſeniate of copper, a variety of gypſum, &c. occur in diſtinct fibres. Asbeſtus, gypſum, red hæmatites iron ore, &c. are found maſſive, and of a parallel fibrous ſtructure: ſome varieties of red hæmatites and other minerals are of a radiating fibrous ſtructure: and the fibres diverge from a common centre.

Filament. A mineral is ſaid to occur in filaments, when it is found in ſlender thread-like or hair-like portions. It is therefore nearly ſynonymous with the term capillary.

Filiform, is uſed in the ſame ſenſe as the preceding; but Werner confines its uſe to expreſs the appearance of certain metals which occur in the form of wire, as native ſilver and native copper.—Filum in Latin, ſignifies thread; filum metalli, wire.

Fiſtuliform. Minerals occurring in round hollow columns, are termed fiſtuliform; fiſtula, in the Latin, ſignifies a pipe. Stalactites and iron pyrites occur fiſtuliform.

Flexible. Talc is flexible; it readily bends, but does not return of itſelf to its original form. Mica is both flexible and elaſtic.

Foliated. This term, which doubtleſs is derived from the Latin foliatus, having, or conſiſting of leaves, is uſed by Werner to expreſs the ſtructure of all minerals that may be divided or cleaved regularly, and are therefore by him ſaid to conſiſt of folia or leaves. The ſtructure of ſuch minerals is more commonly expreſſed by the term lamellar; and they are ſaid to conſiſt of lamellæ or laminæ.

Fracture, is a term now chiefly employed in deſignating the appearance of minerals which have no regular ſtructure, when they are broken: ſuch minerals preſent an even, uneven, or a chonchoidal fracture &c.

Frangible. The term frangibility has relation to the ſuſceptibility of minerals to ſeparate into fragments by force: this quality in minerals is not dependent on their hardneſs; the ſtructure of ſome and the brittleneſs of others, renders them eaſily frangible; while others, which from their ſoftneſs, and the eaſe with which their particles or molecules yield or ſlide over one another, are much more difficulty frangible; ſuch minerals poſſeſs the character of toughneſs. Quartz is eaſily broken, Asbeſtus is tough.

Friable. A mineral whoſe portions or particles ſlightly cohere, and which is therefore eaſily crumbled or broken down, is ſaid to be friable, or in a friable ſtate.

Fungiform. Certain ſubſtances, as for inſtance calcareous ſtalactites, are occaſionally met with having a termination ſimilar to the head of a fungus; whence they are ſaid to be fungiform.

Gangue, Gangart. We have theſe terms from the Germans; the gangue of a mineral, is the ſubſtance, in, or upon which, a mineral is found; it is ſometimes termed the matrix. Silver, occuring in, or upon carbonate of lime, is ſaid to have carbonate of lime for its gangue, or matrix.

Geode. This alſo we derive from the Germans. A geode is a hollow ball; at Oberſtein in Saxony are found hollow balls of agate lined with cryſtals of quartz or amethyſt, which are termed geodes.

Glance is alſo a German word meaning ſhining; thus we have glance-coal, copper-glance, &c.

Globular distinct concretion is uſed to expreſs the character of a mineral which occurs in little round or roundish maſſes; the Pea-ſtone and Roe-ſtone are examples of it.

Granular. The ſtructure of a mineral is ſaid to be granular, when it appears to conſiſt of small grains or concretions; which ſometimes can, ſometimes cannot, be diſcerned without the help of a glaſs; we have therefore the fine granular, and the coarſe granular ſtructure.

Greasy is uſed in relation to luſtre: fat quartz has a greaſy luſtre.

Hackly. This term relates to a fracture which is peculiar to the malleable metals; which, when fractured, preſent ſharp protruding points.

Hæmatites is derived from the Greek αιματιτις, ſignifying blood-red; it was firſt applied by mineralogiſts to the variety of iron ore which is now called the Red Hæmatites; but has ſince been extended to other iron ores of the ſame ſtructure, but differing in colour. We have alſo brown hæmatites, and black hæmatites iron ore.

Hepatic. A term derived from the Latin, hepar, the liver; it is applied either to colour or form. We have hepatic pyrites, hepatic quickſilver; the hepatite.

Hydrate is derived from the Greek ὕδωρ, (udor) water; and is applied to certain of thoſe minerals (as the hydrate of magneſia) of which water forms an ingredient in very large proportion.

Imbedded. A mineral found in a maſs of another ſubſtance, is ſaid to be imbedded in it. Crytallized quartz occurs imbedded in Carrara marble. It alſo occurs partly imbedded in other ſubſtances, as in fluor.

Indeterminate. Indefinite. Theſe terms are uſed ſynonimouſly with Amorphous in deſcribing minerals which have no particular or definable form. Cryſtals of which the form cannot be accurately aſcertained, are ſaid to be of indeterminate forms.

Incrusting: any ſubſtance covered by a mineral, is ſometimes ſaid to be incruſted by it: thus the various articles which are placed for a certain length of time in certain ſprings or wells in Derbyshire, &c. and which are by ſome ſuppoſed to be converted into petrifactions, are only incruſted with calcareous, or argillaceous matter.

Interlacing. Interlaced. When the fibres or cryſtals of a mineral are found intermingling with each other in various directions, they are interlacing or interlaced.

Investing. A mineral ſpread upon, or covering another, is ſometimes deſcribed as inveſting it.

Irridescent. This term relates only to the various colours with which the ſurfaces of ſome metalliferous minerals are naturally tarniſhed: as yellow copper ore, iron pyrites, galena, ſulphuret of antimony, &c.

Lamellar; this term relates to ſtructure: when a mineral can be fractured or cleaved into regular and parallel plates or laminæ, its ſtructure is ſaid to be lamellar; and the portions thus obtained are termed laminæ or lamellæ; theſe terms have been adopted from the Latin, in which they were almoſt ſynonimouſly uſed to expreſs thin plates of any ſubſtance.

Lamellar distinct concretions. This term is ſometimes uſed to expreſs the ſtructure of certain minerals (as the oxide of uranium) conſiſting of laminæ which cohere but ſlightly.

Lamelliform. A mineral conſiſting of lamellæ, is ſaid to be lamelliform.

Laminæ, Lamellæ. See *Lamellar.*

Lenticular is employed to expreſs the forms of certain cryſtals which are nearly flat, and convex above and beneath; and which conſequently reſemble a common lens.

Malleability. Some of the metals ſuffer extenſion when beaten with a hammer; and are therefore termed malleable metals. Native gold and native ſilver are very malleable metals.

Mamillated. See *Botryoidal.*

Massive. This term is ſometimes uſed in deſcribing a ſubſtance of indeterminate form, whatever may be its internal ſtructure; but is more commonly uſed in contra-diſtinction to the term cryſtallized, as applied to thoſe minerals which poſſeſs regular internal ſtructure, without any particular external form.

Matrix. See *Gangue.*

Meagre. This term relates to the touch or feel of a mineral. It belongs chiefly to ſome of thoſe minerals which are of an earthy texture. Chalk is remarkably meagre to the touch.

Natural joints. Such minerals as can be broken into regular forms, as the cube, rhomboid, &c. can be cleaved into thoſe forms, only in the direction of, or along, their natural joints. In ſome minerals however, which have not yet been regularly cleaved, the natural joints are perceptible by the aſſiſtance of a ſtrong light.

Nacreous relates to luſtre; and is employed to expreſs the luſtre of ſome minerals (as of the pearl spar) which greatly reſembles that of pearl. Nacre de Perle, in French, ſignifies Mother of Pearl.

Nodular. A mineral which preſents irregularly globular elevations, is termed Nodular. Flint is found in nodular maſſes.

Opake. Thoſe minerals are opake which do not tranſmit a perceptible ray of light even through the thinneſt and ſmalleſt pieces.

Paſs into. One mineral is ſaid to paſs into another, when both are found ſo blended in the ſame ſpecimen, that it is impoſsible to decide where the one terminates, and the other begins. Flint is found paſſing into chalcedony.

Pectinated. If a mineral exhibit ſhort filaments, cryſtals, or branches which are nearly equidiſtant, it is pectinated; pecten, in Latin, ſignifies a comb.

Porous. A mineral is ſaid to be porous, when it is traverſed in different directions with communicating holes which paſs through the ſubſtance.

Pſeudomorphous. Minerals exhibiting impreſſions of the forms peculiar to the cryſtals of other ſubſtances are ſaid to be pſeudomorphous. Quartz exhibiting cryſtals in the form of the cube; calamine, ſuch as are peculiar to carbonate of lime, &c. are termed pſeudomorphous: *ψευδος*, in Greek, ſignifies falſe; *μορφη*, form or figure: ſometimes they are ſecondary cryſtals.

Pulverulent. When the particles of a mineral are very minute and cohere very ſlightly, or not at all, it is ſaid to be pulverulent; or in the pulverulent ſtate.

Radiated; radiatus, in Latin, ſignifies beſet with rays: when the cryſtals of a mineral are ſo diſpoſed as to diverge from a centre, they are ſaid to be radiated.

Ramoſe; ramus, in Latin, ſignifies the branch of a tree; a mineral having that appearance is deſcribed as being ramoſe.

Refractoriness. This term is uſed both chemically and mechanically in relation to minerals. It is ſometimes applied to thoſe which ſtrongly reſiſt the application of heat; and occaſionally to ſome whoſe toughneſs enables them to reſiſt repeated blows.

Reniform. Kidney-ſhaped; ren, in Latin, ſignifies kidney.

Retiform, Reticulated. Minerals occuring in parallel fibres, croſſed at right angles by other fibres which alſo are parallel, exhibit ſquares, like the meſhes of a net. Retis, in Latin, ſignifies a net. We have reticulated native ſilver, native copper, red oxide of copper, &c. And it may be remarked that ſuch minerals as occur reticulated, generally aſſume the cube, as one of their cryſtalline forms.

Scopiform. If a number of minute cryſtals or fibres are cloſely aggregated into a little bundle, with the appearance of diverging from a common centre, they are ſaid to be ſcopiform. Scopa in Latin ſignifies a broom or beſom.

Schiſtoſe ſtructure. Minerals which ſplit only in one direction, and preſent fragments which are parallel, but of unequal thickneſs, which alſo are not ſmooth and even, and are without luſtre, are ſaid to poſſeſs a ſchiſtoſe ſtructure. Schiſt in the German ſignifies ſlate.

Sectile. This term relates to ſtructure, and is derived from the Latin, ſeco, to cut: Thoſe minerals are termed ſectile which are midway between the brittle and the malleable. A ſlice or portion cut from a ſectile mineral, is fragile, and the new ſurface on the maſs is ſmooth and ſhining. Plumbago and the ſoapſtone are both ſectile.

Semi-tranſparent. A mineral is ſaid to be ſemi-tranſparent when an object is not diſtinctly ſeen through it.

Slaty-ſtructure. This term is ſynonimous with Schiſtoſe ſtructure, which ſee.

Specific Gravity. The ſpecific gravity of minerals is determined by compariſon. The uſual mode of determining it, is by weighing them in pure diſtilled water; the weight of which is aſſumed to be one or unit. Earthy minerals vary from twice, or leſs than twice, to nearly five times the weight of diſtilled water. Metalliferous ores and native metals vary from five to ſeventeen times its weight; ſome minerals, eſpecially ſome of the combuſtibles, are lighter than water, and are of courſe ſupernatant.

Specular Minerals are thoſe which preſent one ſmooth and brilliant ſurface which reflects light. We have ſpecular red iron, ſpecular iron pyrites, &c. Theſe are ſaid always to occur cloſe to the walls or or ſides of veins. Speculum, in Latin, ſignifies a looking glaſs.

Spicular and Splintery Fracture belong to minerals of an imperfectly cryſtalline form. Theſe fractures do not greatly differ: they are both irregular; the ſpicular is ſhorter and more pointed than the ſplintery.

Stalactitiform. ϛαλάγμα, (ſtalagma) in the Greek, ſignifies a drop, an icicle. Stalactitiform minerals greatly reſemble icicles in ſhape.

Stellated. When the ſtructure of a mineral is fibrous, and the fibres diverge all round a common centre, its ſtructure is ſaid to be ſtellated: ſtella, in Latin, ſignifies a ſtar.

Striæ, Striated. The ſlight channels occaſionally obſervable on the planes of cryſtallized minerals are termed ſtriæ, and the cryſtals on which they are ſeen are ſaid to be ſtriated. The ſtriæ are commonly parallel and generally indicate the direction in which cryſtals may be cleaved. Stria, in Latin, ſignifies a groove, or channel.

Structure. This term relates to the internal characters of minerals. Such as can be cleaved into regular forms, preſenting ſmooth, brilliant, and parallel ſurfaces, are ſaid to have a cryſtalline ſtructure; but when the ſurfaces are neither ſmooth nor parallel, and when, on the contrary, they are rough and curved or undulating, the ſtructure is ſaid to be imperfectly cryſtalline: under which term alſo may be comprehended all fibrous minerals whether maſſive or not. All ſuch as have no determinate ſtructure, as thoſe minerals which are granular, ſplintery, &c. or compact, may be included under the term indefinite or promiſcuous ſtructure.

Supernatant. Such minerals as are lighter than water, and conſequently ſwim upon it, are ſaid to be ſupernatant. Supernato, in Latin, ſignifies to ſwim or float upon.

Tabular. When this term is uſed in relation to ſtructure it is nearly allied to the ſchiſtoſe or ſlaty. Talc, mica and roofing ſlate are deſcribed by Werner as poſſeſſing a tabular ſtructure. This term ſometimes is uſed to expreſs the external form of cryſtals: ſuch as are nearly flat, and whoſe length and breadth are nearly the ſame, are ſometimes called tabular cryſtals: from the Latin, tabula, a table or board.

Toughneſs relates to internal ſtructure. Thoſe minerals which are bruiſed, or ſuffer depreſſion, by repeated blows in the attempt to fracture them, are eſteemed to be tough.

Translucent. A mineral through which an object cannot be ſeen, but which tranſmits ſome light, is termed tranſlucent. Rock ſalt, ſometimes quartz, flint and fluor, &c. are tranſlucent: many minerals are tranſlucent on the edges, as common marble, &c.

Transparent. Thoſe minerals are tranſparent through which an object may be clearly ſeen.

Tubercular. A mineral whoſe unevenneſs of ſurface ariſes from ſmall and ſomewhat round elevations, is ſaid to be turbercular. Flint is ſometimes tubercular.

Tuberous: exhibiting ſomewhat circular knobs, or elevations.

Tubular: See fiſtuliform.

Vesicular. A mineral is ſaid to be veſicular, when it has ſmall and ſomewhat round cavities, both internally and externally. Lava, pumice, limeſtone, baſalt, &c. are ſometimes veſicular: from the Latin, veſicula, a little bladder.

Vitreous; from the Latin, vitreus, glaſſy; minerals having the luſtre of glaſs, are ſaid to poſſeſs the vitreous luſtre.

Unctuous. The term relates to the touch. Pipe clay is ſomewhat unctuous: Fullers' earth is unctuous: plumbago and ſoapſtone are very unctuous.

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UNIV. OF CALIFORNIA

SILEX.

This Earth is, when pure, in common with the rest of the earths, perfectly white and infusible, except by the intense heat of voltaic electricity. It has neither taste nor smell, and its specific gravity is 2.66.

Silex has never been found mineralized by any acid, but is occasionally involved in small proportion in some of the acidiferous earthy substances; it forms a large ingredient of very many earthy minerals, including some of the hardest gems and the softest clays; it is proved by analysis to enter, in variable proportion, into the composition of about two-thirds of the whole number of earthy minerals whose composition is known; and as it is the chief ingredient of the oldest and most plentiful of the primitive rocks, and is found in rocks of almost every age and formation, it is esteemed to be the most abundant substance in nature.

Silex, as well as the rest of the earths has lately been proved, by Sir H. Davy, to be a compound substance; it consists, according to Berzelius, of oxygen, in the proportion of about 54 per cent, united with a base, *Silicium*, which has not hitherto been obtained in a state of separation, in the proportion of about 46 per cent. Silex cannot therefore be now considered as a simple or elementary body.

Notwithstanding the complete analysis of *silex*, it still obtains among chemists its old denomination of an Earth; principally, it may be supposed, from the difficulty of properly characterizing its base; which is not believed by Sir H. Davy to be a metal, but of a peculiar nature, bearing an analogy to boron, charcoal, sulphur and phosphorus.

As common flints are almost wholly composed of *siliceous earth*, it thence received the name of Silex, which in the latin signifies flint; but it is found in the greatest purity in quartz or rock crystal.

QUARTZ.

Quartz is found crystallized, fibrous, granular, and compact. It scratches glass, does not yield to the knife, and is infusible. Its specific gravity is 2.6; and it is composed of silex, with 2 or 3 per cent. of water.

*Crystallized quartz** is found perfectly transparent and colourless; also, red, yellow, grey, black, brown, purple, green, and of various shades of each colour.

The transparent and colourless is known by the name of rock Crystal: the largest and most esteemed crystals are brought from Madagascar, the Alps, Norway, and Scotland; where they are found in cavities in granite. Single crystals have been met with, of more than 100 lbs. weight. These are bought at a high price by the lapidary, to cut up into various ornaments, as seals, &c. and into proper forms for spectacles, as a substitute for glass. In smaller crystals, quartz is found in almost every metallic vein, both of ancient and recent formation, in every kind of rock.

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* *Cryſtallized Quartz.*—Unconnected cryſtals of quartz, in my poſſeſſion, from Tonewanto, are in the eighteen ſided form, ſhining with remarkable brilliancy. Others from Rocheſter, north-weſt of the Shawangunk mountain, have as many ſides, with longer columns; found ſcattered through argillaceous loam.—*Abraham G. Thompſon.*

Attached cryſtals of great beauty have been brought from Rocheſter, having a ſix ſided column terminating in a ſix ſided pyramid. Some of them poſſeſs remarkable clearneſs and brilliancy, and form cluſters of great beauty. They reſt upon a baſe of quartzy rock, containing galena, or ſulphuret of lead, and blende, or ſuphuret of zinc.—*Ib.*

A cryſtal of this ſort, in my collection, brought by a Canadian trader from ſome barbarian region north-weſt of Lake Superior, is 5 inches long, and 1 1-2 in diameter.—*Rev. Alex. M'Leod.*

Many handſome ſpecimens of naſcent and well formed cryſtals of quartz have been brought from Rhinebeck.—*Rev. F. C. Schaeffer.*

Well formed and lucid cryſtals have been brought from Diamond Iſland, in Lake Champlain.—*Stevenſon.*

Elegant cluſters of the same, from the banks of the Illinois.—*Long.*

Opake cryſtals of quartz, reſting upon gneiſs, from the Stafford Springs, in Connecticut.—*Davis.*

The Diamond Rock, ſituated eaſt of Lanſingburgh, has a ſurface beſpangled with minute cryſtals, that glitter in the ſunſhine, and tempt moſt viſiters to bring away pieces of the quartzy rock. and its crop of cryſtals.

Quartzy cryſtallizations are found in various other parts of the United States and of North America; ſuch as Maſſachuſetts, Virginia, South Carolina, and other places.

Quartz, more often than any other crystallized mineral, contains foreign substances: sometimes drops of water, with bubbles of air, may be seen in it; also crystals of schorl or titanium, crystals of chlorite, and iron ore.

The crystallizations of quartz or rock crystal are very interesting. The crystals in my possession exhibit 40 distinct varieties of form; the most common of which is a hexahedral prism terminated by hexahedral pyramids: the two pyramids joined base to base, without an intervening prism, are rarely seen. The primitive crystal is also rare, but is occasionly found in the neighbourhood of Bristol; it is an obtuse rhomboid, very nearly approaching the cube. Its angles, according to Haüy, are 94° 24′ and 85° 36′; but the results obtained by the reflecting goniometer do not correspond therewith.

Quartz allows, though not readily, of mechanical cleavage, parallel with the planes of its primitive crystal.

The transparent crystals found in the neighbourhood of Bristol, termed *Bristol Diamonds*, are crystallized quartz; those of Cornwall are by some called *Cornish Diamonds*.

Crystals of quartz, of a light yellow, or of various shades of brown, are brought from many places. The best are found in a hill called Cairn-gorm, in Scotland. A single crystal about twelve inches long, and four in diameter, of a deep brown colour and transparent, which was fit for the lapidary, was not long since sold by public auction for 210 guineas. These are by some called *False Topazes*.

When of a reddish purple, or violet colour, quartz is called *Amethyst*:* the crystals are generally of the deepest colour towards the summit. It commonly occurs in veins in metalliferous mountains in Spain, Bohemia, Saxony, Hungary, &c. never in those of primitive granite. Frequently it is found in hollow masses, called geodes, which are occasionally surrounded by a coating of agate; but these are principally met with in volcanic countries; in Auvergne, the Tyrol, and the Palatine. Analysis has proved the amethyst to contain a very minute quantity of iron and manganese, to which its colour may be attributed. Amethyst has been met with in the tin mines of Cornwall, Polgooth, and Pednandrae.

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* *Amethyst.*—My collection contains hollow balls, covered within by amethyſtine cryſtals, from Mentz, in Germany, and amorphous pieces of various purple hues, from St. Salvadore, in Brazil, and its vicinity. Mr Collins brought me an amethyst found in Georgia, thirty miles west of Augusta.

Fibrous quartz[*] is yellowish or greyish white, and occasionally pale amethyst: sometimes it occurs in radiated and globular concretions, two inches or more in diameter, but only in Cornwall.

Granular quartz[†] is white, yellowish or greyish white; it occurs in granular distinct concretions, sometimes in mass, and as a component of certain granites. It is fine, or large grained. The fine grained, with silvery mica, composes a granite near Schihallien, in Scotland; the larger grained forms large blocks in argillaceous schistus and other rocks in Scotland. The latter becomes snow white by calcination, and is largely employed in the porcelain manufactory.

Compact quartz[‡] is of various colours, and occurs in mass, or disseminated, or globular, &c. It is found entering into the composition of rocks, from the oldest to those of the most recent formation, and composing veins and beds in others: sometimes it is found in considerable blocks, though it seldom forms entire mountains.

Prase[§] is of a leek green colour, and translucent; it occurs in mass at Brutenbrun, in Saxony, in a mineral bed: it appears to be an intimate mixture of quartz and actinolite.

When of a light grass or an apple green, and somewhat transparent, quartz is termed *Chrysoprase*, which is found in mass, imbedded in serpentine, in Siberia, with opal, chalcedony, &c.

Avanturine is yellowish red, or grey, greenish, or blackish. It appears to be filled with silvery and yellowish spangles, that reflect light with great brilliancy. Some suppose these spangles to be mica, others imagine that the appearance is produced only by the particular direction of the laminæ. It takes a good polish, and is used for seals and other ornaments. The best avanturine is brought from Spain.

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[*] *Fibrous Quartz.*—This frequently occurs, croſſing veins of granite, gneiſs and ſchiſtus, in New-York. It ſeems to be an incipient form of cryſtallization.

[†] *Granular Quartz*—frequent in and around New-York.

[‡] *Compact Quartz*—many diſtinct maſſes are found scattered over the land between Waſhington city and Fredericktown, Md.

[§] *Prase.*—Specimens of quartz, coloured green, at New-York and its vicinity. They are, however, opake and amorphous, and have been ſuppoſed to owe their colour to copper.

A variety of quartz, which is commonly massive, and has a greasy lustre, as though it had been rubbed with oil, is therefore called *Fat quartz*:[*] it is one of the gangues of native gold in Peru.

Another variety is opaque white, and is thence termed *Milk quartz*. It has sometimes a tinge of red, which often passes into a beautiful rose red, when it is termed *Rose quartz*;[†] it often has the greasy lustre of fat quartz. Its colour is said to be owing to manganese. It has been found at Rabenstein in Bavaria, in considerable quantity, in a vein of manganese traversing a large grained granite. It has also been met with in Finland, and near Cork in Ireland.

Quartz sometimes exhibits impressions of the crystalline forms of substances on which it has been deposited, but which have been decomposed; quartz exhibiting such crystalline appearances is termed *Pseudomorphous*.[‡] Sometimes it is merely cellular; and when the cavities are very minute, and the quartz is in very thin plates which intersect each other in every direction, it is so light as to swim on water; whence this variety has been termed *Swimming stone*, by some *Spongiform quartz*. It has been found at Schemnitz in Hungary, at Joachimstal in Bohemia, at Schneeberg and Freyberg in Saxony, at Beresof in Siberia, and in Cornwall in England. The cavities of one specimen in my possesion, from Pednandrae Mine, near Redruth, are partly filled up with fluor spar, the external parts of which are rounded, shewing it to be in a state of decomposition; the cavities of another, from Relistean Mine, are filled up partly by black, partly by bright yellow copper ore.

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[*] *Fat Quartz.*—Particles of this variety adhere to the pieces of native gold found in North Carolina.

[†] *Rose Quartz.*—I have elegant ſpecimens from Maine, received from Profeſſor Cleaveland.

[‡] *Pseudomorphous Quartz.*—Cryſtals of quartz ſometimes make impreſſions upon inveſting quartzy maſſes of ſubſequent formation; and ſometimes the quartzy cruſts or boxes remain, after the ſofter and more periſhable materials they encloſed, are decompoſed or waſhed away.

Quartz combined with variable proportions of iron, is termed *Ferruginous quartz*:[*] It is of a yellow or red colour, and opake, and is found both compact and crystallized. It is harder than pure quartz; and when heated, becomes magnetic. It is sometimes met with in remarkably neat small crystals having both terminations perfect, and of a yellowish or reddish colour. These crystals have been principally found in secondary rocks, near Compostella in Spain; whence they are called *Hyacinths of Compostella.* Massive ferruginous quartz, or *Eisenkiesel*, is found in the veins of primitive mountains, where it is often met with as the gangue of various metallic substances, as of lead, copper, sulphuret of iron, and sometimes of gold.

A variety termed *Hyalite*, or *Muller's glass*, having in many respects the appearance of chalcedony, has been found in small masses upon, or lining the cavities of, amygdaloid. It bears a striking resemblance to gum-arabic, and is said to be composed of 92 parts silex and 7 of water. It has been found only in volcanic countries: in Tuscany,—in small stalactites in the rocks of Piperino, in Solfatara, &c.

Quartz is sometimes found forming beds, and more often veins,[†] in primitive mountains. The quartz in these veins is sometimes compact, but is occasionally hollow in places; in these cavities the crystals which are seen in the cabinets of mineralogists are found. It occasionally occurs imbedded, as in porphyries; and in remarkably neat transparent crystals, in Carrara marble.

It is also met with in veins or caverns in secondary countries of different natures; and forms a large proportion of alluvial deposites, principally in fragments, or rounded or angular grains, constituting sand; which is sometimes, by causes which we know not how to explain, found adhering, forming masses denominated *Sandstone*[*] and *Gritstone.*

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[*] *Ferruginous Quartz.*—Amorphous, reddiſh or ruddy quartz, ſtained through and through, or in ſpots and blotches, are of frequent occurrence.

[†] *Veins of Quartz.*—These occur in the rocks of gneiſs and granite, in the islands of the Sound east of New York, of various width, from half an inch to three feet; sometimes parallel to the strata, and sometimes across them. The quartz is even a rod wide, in certain places.

OPAL.

Opal is either of a clear, or of a bluish white: it includes several varieties.

It is found in small masses or in veins in Hungary, in rocks which seem to be in part decomposed, and which are by some considered to be volcanic; by others, as argillaceous rocks, the result of the decomposition of porphyries. In these rocks both the common and the noble opal occur. Opal is also met with in Iceland, and Saxony.

The *Common opal* is usually white with a tinge of yellow, red, or light green, internally. It consists of 93.5 parts of silex, 1 of oxide of iron, and 5 of water. It has been found in several of the mines of Cornwall.

The *Noble opal* exhibits changeable reflections of the same colours as the former variety, and is an exceedingly brilliant and beautiful mineral: it is hard enough to scratch glass. The finest specimens of it are in the Imperial Cabinet of Vienna; one is about 5 inches long and 2½ in diameter, the other is of the shape and size of a hen's egg. It consists of 90 parts of silex, and 10 of water.

Semi-opal is harder than the preceding varieties and is mostly opake; occasionally transparent, with a glistening resinous lustre. It is principally met with in secondary countries; sometimes in volcanic rocks, and in basalts. It has also been found in primitive granite and porphyry, especially in the veins traversing those rocks which contain silver. It consists of 85 per cent. of silex, 1 of carbon, 1.75 of oxide of iron, 8 of ammoniacal water, and a small portion of bitumen. Semi-opal is found in Auvergne in France, in the island of Elba, in Bohemia, Iceland, Hungary, &c. Fossil teeth have been found penetrated by this mineral.

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[*] *Sandstone.*—At Nyack, thirty miles north of New-York, the Sandstone strata, overlay the bones of land animals. The roots of the kalmia latifolia are petrified in red Sandstone, near the top of the Kaatskill mountain.—*(Eaton.)*———And both marine shells and vegetable substances are embraced in the Sandstone, near Rappahannock and York rivers, in Virginia.—*(Latrobe.)*———Quartz, in loose and round pebbles, chiefly conſtitutes the ſhoals and beaches of the Atlantic ſhore, from Cape Cod and Nantucket to Cape Hatteras, and beyond.

Wood-opal * has a ligneous structure, and is met with of various shades of grey, brown and black. It appears to be wood, penetrated by opal or semi-opal; and is found near Schemnitz, and at Telkobanya in Hungary.

A variety, met with at the same place as the preceding, called *Ferruginous Opal* or *Opal jasper*, is of a yellowish or yellowish brown colour, with a glistening resinous lustre. It consists of about 43 parts of silex, 47 of oxide of iron, and 7 of water.

HYDROPHANE.

The Hydrophane is considered to be a variety of opal. It is generally whitish, and nearly opake; by immersion in water, it exhibits some of the changeable colours of the former varieties, and is found in the same places. It consists of about 93 parts of silex, 2 of alumine, and 5 of water.

Hydrophane is porous, and commonly adheres to the tongue. It is chiefly found in Saxony, the Isle of Ferroe, and in Hungary. At Mussinet near Turin, it occurs in veins of chalcedony, or of hard serpentine, traversing a serpentine mountain in every direction.

MENILITE.

The Menilite is by some considered a variety of semi-opal. Its common colour is a smoke brown; its structure slaty; it is somewhat translucent, and is found in irregular masses in beds of clay, between beds of sulphate of lime at Menil-montant near Paris. It is sometimes called the *Pitchstone of Menil-montant*. It consists of 85.5 parts of silex, 1 of alumine, 11 of water and inflammable matter, with small portions of lime and oxide of iron.

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* *Wood-Opal.*—Wood apparently opalized has been picked up on the Banks of the Miſſouri.—*Bradbury.*

FLINT.*

Flint is of various shades of white, yellow, brown and black, and is somewhat harder than common quartz; it is readily broken in any direction, and has a conchoidal and a glimmering lustre. It is found in irregular masses, and sometimes forming the substance of certain marine organic remains, as echinites and coralloids: and consists of 97 parts of silex, 1 of alumine and oxide of iron, and 2 of water. It specific gravity is 2.58

Flint is said occasionally, though rarely, to be found in veins in primitive rocks; but it is also said that the flint thus found has not precisely the characters of common flint. It is met with in nodules in compact carbonate of lime in Derbyshire; at Mont-martre near Paris, in an impure sulphate of lime; it is also found in certain marls; but that which may be termed its ordinary native place, is the upper chalk formation, in which it is met with in regular layers, and occasionally as in Freshwater Bay in the Isle of Wight, in continuous beds of considerable length. Flint is also abundantly found in portions evidently rounded by attrition, forming deposites in the neighbourhood of chalk hills, and of gravel in alluvial countries. When red, yellow, or brown, they are termed *Ferruginous flints.*

The formation of the flints which lie in detached masses, though in parallel layers, in chalk, has much occupied the attention of geologists, and without producing any satisfactory solution. Their form proves that they have not been rolled, or conveyed into the chalk; in which they bear every appearance of having been formed: they are frequently found containing shells. Some naturalists have ventured on the supposition that the places in which they are found were formerly occupied by animals: and that the formation of flints in those places, has been owing either to the affinity existing for silex in the animal matter, or that it has been converted into flint. This it must be obvious is mere hypothesis, and is not more deserving of regard than the notion entertained by others, that, contrary to all known principles of chemistry, these flints have been formed by the conversion of lime into silex by some unknown natural agency. The most commonly received opinion seems to be, that flints have been formed by the filtration of siliceous matter through the chalk; a theory not without serious difficulties.

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* *Flint*—Is found in detached maſſes, of the ſize of a fiſt and leſs, ſcattered over the maritime alluvion of the United States. But as it does not break with a proper concavo-convex fracture, it may be deemed rather a horn-ſtone; or rather it is horn-ſtone paſſing into flint, found in the ſtrata of ſecondary lime-ſtone, in the counties of Otſego, Geneſſee and Niagara, New-York; generally of a black hue; is frequent in the valley of Muſconetcung river, New Jerſey, and between the Delaware and Lehigh, Pennſylvania. Various other localities of flint, are detailed in my letter on the ſubject, as publiſhed in Mease's Archives of uſeful knowledge, at Philadelphia. Specimens in my poſſeſſion, from Alabama and Brazil, ſhow the ſtages by which flint changes to limeſtone, or limeſtone alters to flint.

Kirwan quotes from Schneider's Topog. Mineral. 114. that 126 silver coins were found enclosed in flints, at Crinoc in Denmark; and an iron nail at Potsdam.

CHALCEDONY.*

Chalcedony is found of various shades of white, yellow, brown, green and blue. It occurs massive, forming veins, in round balls, termed geodes; and also, botryoidal and stalactitical; sometimes it bears the impression of organized bodies: it is frequently met with coating crystals of quartz, and occasionally in cubic crystals, which, it is ascertained, are only secondary, or pseudomorphous, It is commonly semi-transparent; it has no regular fracture, and is harder than flint. Its elementary constituents have not been accurately ascertained, but as it is often found passing into flint, it may reasonably be assumed, that their analysis would not greatly differ. The specific gravity of chalcedony is about 2.6.

Chalcedony is found principally at Oberstein in Saxony, and in the isle of Ferroe. A blue variety is met with in Transylvania. That of Iceland is in thin layers, alternately more or less translucid, and perfectly parallel. But the most superb specimens were brought from a copper mine in Cornwall, called Travascus, which was situated in argillaceous schistus; these specimens are translucid, whitish, and variously ramified. A variety of a beautiful blue colour on the surface was found in a tin vein passing through granite, in Pednandrae mine, near Redruth, in the same county; and another variety, very much resembling flint, containing small portions of yellow copper, in Relistian mine. Chalcedony has also been met with in several others of the Cornish mines. It was anciently procured from Chalcedon in Upper Asia, whence its name.

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* *Chalcedony.*—Coarſe pieces found along the ſhores around New-York.

When of a white colour and translucent, chalcedony is called *Cacholong*. Some varieties are opake and adhere to the tongue. Cacholong is found with chalcedony, sometimes with flint. It is met with at Champigny, near Paris, in a calcareous breccia: but the real cacholong is found in the banks of the Cach, a river in the country of the Calmucs of Bucharia.

When chalcedony contains appearances of arborization or vegetable filaments, which have been supposed to be owing to the infiltration of iron or manganese through its natural crevices, it is termed *Mocha stone*. This is believed chiefly to be brought from Mocha in Arabia.

Carnelian is of various shades of yellow, brown, and red. It is found in several places in Europe; but the most valuable specimens are brought from Arabia, and from Surat and Cambay in India, where it is said to be found in certain rocks in the globular, or the stalactitical form.

Sard is supposed to differ from the preceding variety only in its colour, which is orange-yellow, passing into brownish-yellow.

When yellowish, white, red, or yellow, brown, or brownish black, and opake, it is called *Jasper*.

When two or three of the above varieties are mixed in alternate and concentric bands, exhibiting, when cut and polished, zones, or angular lines like fortifications, the compound is termed *Agate*. It is found in the form of irregular rounded nodules, from the size of a pin's head to more than a foot in diameter, or in veins or strata, or occasionally stalactitic. Sometimes agate is found in amygdaloid and in gypsum; near the Wolga it occurs between strata of secondary limestone. The most beautiful agates of Britain are found in the neighbourhood of Perth and Dunbar, and are called *Scotch pebbles;* but the most celebrated are those of Oberstein, in Saxony. When the colours are disposed in straight parallel bands, it is called *Ribbon agate*, by some *Ribbon jasper*. Another variety represents rocks or buildings, and is called *Ruin agate*.

But if two or more of the preceding varieties are associated with a band of milk-white opake chalcedony, the mass is called *Onyx*. Onyxes cut into portions about the size of a bean, exhibiting opake white circles, resembling the iris of the human eye, are termed *Onyx-eyes*.

Sard, united with opake milk-white chalcedony, is called *Sardonyx*.

Plasma seems to be a variety of chalcedony, which it resembles in being translucent, and somewhat harder than quartz. It is of a dull greenish colour, with yellow and whitish dots, and has a glistening lustre. It has not been analyzed. Plasma is brought from Italy and the Levant; and is said to occur at Taltsa, in High Hungary; also, disseminated in rounded pieces, with flint and hornstone, in a mountain of serpentine, at Bojanowitz, in Moravia. Its specific gravity is 2.04.

Heliotrope is mostly of a deep green colour, and translucent; and commonly, yellow or blood-red spots are interspersed through the substance. From the latter circumstance it has obtained the name of *Bloodstone*. It is considered to consist of chalcedony coloured by chlorite, or by green earth; and is found in Siberia, Iceland, and in a vein at Jaschkenberg, in Bohemia,—but the most beautiful varieties are brought from the east; whence, among lapidaries, by whom it is in considerable request, it has obtained the name of *Oriental jasper*. The specific gravity of heliotrope is 2.6.

CIMOLITE.

Cimolite is of a light greyish-white, inclining to pearl-grey, but by exposure to air it acquires a reddish tint; it occurs massive, and of a somewhat slaty structure; is opake; yields to the nail, and adheres to the tongue. It often encloses small grains of quartz. It consists of 63 parts of silex, 23 of alumine, 1.25 of oxide of iron, and 12 of water. Its specific gravity is 2.

It abounds in the island of Cimola (whence its name) now called Argenteria, situated near that of Milo. It was employed by the ancients, and still is by the inhabitants of the island, for some of the purposes to which fuller's earth is applied.

BLACK CHALK. DRAWING SLATE.

This mineral is of a greyish or bluish black colour; it has a slaty structure, is meagre to the touch, and soils the fingers. It is found in primitive mountains, accompanying argillaceous schistus, particularly that which is aluminous, to which it is nearly allied; and is said to occur occasionally in the neighbourhood of coal formations. It is met with near Pwllhelli, in Caernavonshire; in Isla, one of the Hebrides; in France, Spain, Italy, Iceland, and in Bareith. That from the latter place yields by analysis about 64 parts of silex, 11 of alumine, 11 of carbon, with small proportions of iron and of water.

ALAMANDINE.

This mineral, commonly termed *Noble*, or *Precious garnet*, is usually of a brilliant crimson colour, sometimes with a slight smoky tinge and transparent. It occurs granular, and also crystallized, in some of the forms usual to the common garnet; its structure is imperfectly lamellar, though but rarely visible. Its specific gravity is 4.3; and it consists of 35.75 parts of silex, 27.25 of alumine, 36 of oxide of iron, and 0.25 of oxide of manganese.

The alamandine is very much esteemed as a precious stone. The most beautiful, which are sometimes of reddish violet colour, are brought from Sirian, the Capital of Pegu: among lapidaries, they are improperly called Syrian garnets. They appear to be the *Carbuncle* of the ancients. Of their geological situation in Pegu, we are entirely ignorant. They are also found in Bohemia, Hungary, Ethiopia, Madagascar, Brazil, &c.

In Bohemia, they are found near Meronitz and Trziblitz, in the circle of Leutmeritz, disseminated in an alluvial deposite, consisting principally of fragments of serpentine or rounded masses of basalt, cemented by a grey marl. In this deposite are also found hyacinths, beryls, sapphires, quartz, magnetic iron, and even fossil shells.

It is said to have been met with in granite at Strontian; also at Ely in Fifeshire, and at Wicklow in Ireland.

TABULAR SPAR.

This very rare mineral has only been found at Oravitza, and at Dognaska, in the Bannat of Temeswar, entering into the composition of a rock, consisting principally of bluish carbonate of lime and brown garnets; or, according to others, in a vein of bluish lamellar carbonate of lime, containing green garnets.

The tabular spar is of a greyish white colour; translucent and somewhat hard. It is phosporescent when scratched with a knife, and is said to have been met with in six-sided tables, in which the natural joints may be discovered, parallel to the sides of a slightly rhomboidal prism. It is composed of 50 parts of silex, 45 of lime, and 5 of water. Its specific gravity is 2.86.

JENITE. YENITE.

The Yenite is a scarce mineral, which at first sight greatly resembles hornblende. It is of a brown, or brownish black colour, dull externally, and of about the hardness of felspar It occurs amorphous, acicular, and crystallized; generally in the form of a rhomboidal prism; six varieties have been discovered in the form of its crystals, the primitive of which is a rectangular octohedron, measuring over the summit, according to Haüy, one way, 112°. 36′, the other, 66°. 58′. it is composed of 29 parts of silex, 12 of lime, and 57 of the oxides of manganese and of iron; and therefore does not seem to belong to earthy minerals; but it is always ranked in that class. Its specific gravity is 3.8.

It has been found only in Corsica, at Rio la Marine and Cape Calamite; it is dispersed in crystals and almost compact round masses, in a thick bed of green substance, the nature of which has not been determined, but which bears a considerable analogy to the Yenite; and is accompanied by yellowish-green epidote, quartz, and arsenical iron. The bed containing the yenite lies upon another, consisting of large grained carbonate of lime, enclosing talc. At Cape Calamite it is accompanied by magnetic iron ore, granite, and quartz.

STEATITE.[*]

Steatite is of various shades of white, grey, yellow, green, and red; and is met with massive, and (at Bareuth) with occasional appearances of internal crystallization; which, being mostly, if not always, referable to the forms assumed by quartz or carbonate of lime, are therefore in varieties which cannot originate in the same primitive form, and are thence considered to be only pseudomorphous.

This substance has generally a very unctuous and soapy feel, but it differs from the soapstone in not having alumine as one of its elementary ingredients; it yields to the nail, but does not adhere to the tongue; its fracture is splintery, sometimes slaty. It considerably resembles some varieties of serpentine, but is much softer. The grotesque figures brought from China, are generally supposed to be a variety of steatite; which, though it possesses some characters in common with the substance of which those figures are made (the Agalmatolite), differs essentially in respect of analysis. Steatite consists of 64 silex, 22 magnesia, 3 oxide of iron, and 5 of water. Its specific gravity is 2.67.

Steatite is found in considerable masses, or in beds or veins, in some primitive mountains. It is most common in serpentine. At Freyberg in Saxony, it is met with in tin veins; where it is accompanied by, or mingled with mica, asbestus, quartz, and occasionally native silver, &c. It is found at Portsoy, in Scotland, in serpentine, and in the Isle of Sky, in wacke. It occurs also in the Isle of Anglesey. It abounds in the principality of Bareuth, in Saxony, Bohemia, Norway, Sweden, and France.

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[*] *Steatite.*—Found in the alluvial soil of New-York city, in looſe maſſes; in the county of Richmond, (N. Y.) near the health eſtabliſhment, aſſociated with various other magneſian productions; and near Baltimore in Maryland accompanying the native chromate of iron.

The white varieties, or those that become so by calcination, are employed in the manufactory of the finest porcelain: other varieties are said to be used for fulling. The Arabs, according to Shaw, use steatite in their baths instead of soap, to soften the skin; and it is confidently asserted that the inhabitants of New Caledonia either eat it alone, or mingle it with their food. Humboldt says that the Otomaques, a savage race, inhabiting the banks of the Oronoko, are almost entirely supported during three months in the year, by eating a species of steatite, which they first slightly bake, and then moisten with water.

BRONZITE.

The colour of this mineral is brown, having frequently the aspect of bronze; its structure is fibrous lamellar, and its lustre is considerably metallic. It consists of 60 per cent. of silex, 27.5 of magnesia, 10.5 of oxide of iron, and 0.5 of water. Its specific gravity is 3. 2.

The Bronzite is usually found disseminated in Serpentine. It occurs in the Col de Cervière in the Alps; at Matray in the Tyrol; at Basta in the Duchy of Wolfenbutel; at Dobschau in Upper Hungary, &c.: It seems to belong to primitive countries.

LAUMONITE.

This mineral occurs in aggregated crystalline masses, deeply striated, or in separate crystals of several varieties of form; the primitive of which, according to Haüy, is a rectangular octohedron, or, according to Bournon, a rhomboidal tetrahedral prism, with rhombic bases.—

The Laumonite is white, transparent or translucent, and hard enough to scratch glass. It was formerly termed the *efflorescent zeolite*, on account of its undergoing a spontaneous change by exposure to the air; in consequence of which it loses its natural transparency, and becomes opake, tender, of a shining white colour, and pearly lustre; eventually, it falls into a white powder, similar to that resulting from the decomposition of Glauber's Salts. It has lately received the name of the Laumonite, from Gillet De Laumont, who first made known its true nature. Its specific gravity is 2, 2. It is composed of 49 of silex, 22 of alumine, 9 of lime, 17. 5 of water, and 2. 5 of carbonic acid.

This mineral was first discovered in the lead mine of Huelgoet in Brittany, lining the cavities of the veins.— It has since been brought from Ferroe; from near Paisley in Renfewshire; from Portrush in Ireland, and Larne in the Isle of Sky.

DIPYRE.

This rare substance occurs in slender octohedral prisms, of a greyish, or reddish white colour, fasciculated into masses. These prisms exhibit joints parallel to the sides, and to the diagonal, of a rectangular prism The Dipyre is of a shining vitreous lustre, is hard enough to scratch glass, and becomes slightly phosphorescent by the application of heat. It consists of 60 of silex, 24 of alumine, 10 of lime, and 2 of water. Its sp. gr. is about 2, 7.

It was found in the torrent of Mauleon, in the western Pyrennees, in a gangue of white, or reddish steatite, mingled with sulphuret of iron.

STILBITE.

Stilbite is of a peculiar glistening or shiny pearly lustre, by which it may be recognized at once. Its colours are white, grey, brown, or red; it is transparent or translucent, and not sufficiently hard to scratch glass. It occurs lamelliform, massive, and crystallized; the crystals are sometimes fasciculated into slender prisms: the form of the primitive crystal is a right prism with rectangular bases, in which it sometimes occurs, but more often these prisms are terminated by tetrahedral summits. It consists of 52 parts of silex, 17. 5 of alumine, 9 of lime, and 18. 5 of water. Its sp. gr. is 2, 5.

The Stilbite is met with in the fissures of primitive rocks; in mineral veins; and in the cavities of amygdaloid.

It has been found near Grenoble, of a pale straw colour; at Andreasberg, upon carbonated lime; at Arendahl, in Norway, of a brown colour; in Iceland, of a shining white colour, on the Iceland spar; in the islands of Sky, Staffa and Canna, in amygdaloid; and it has been met with massive, of an orange brown colour, at Dumbarton; at Glen Farg in Perthshire, and at Callhill in Aberdeenshire.

CAT'S EYE.

This mineral is generally brought in the polished state from the coast of Malabar, and from Ceylon; but nothing is known of its geological situation. Its colour is of various shades of grey, green, brown, or red; and it exhibits a peculiar play of light, resembling the eye of the animal from which it takes its name; this peculiar reflection, emphatically termed by the French, chatoyant, is owing to the fibrous texture of the substance, arising, as it has been supposed by some, from its consisting of asbestus, enclosed in quartz. Its specific gravity is about 2. 7. It is composed of 95 parts of silex, 1. 75 of alumine, 1. 5 of lime, and 0. 25 of oxide of iron. It is frequently employed as a precious stone, and is in considerable estimation.

PREHNITE.

This mineral is of a pale greenish or yellowish colour, with a shining pearly lustre, and is somewhat transparent; it is scarcely hard enough to scratch glass, and becomes electric by heat. It occurs in very minute crystals, which are for the most part closely aggregated; their primitive form is a right rhomboidal prism of 103°. and

77° ; the prisms sometimes have 6 or 8 sides. A variety which occurs in small translucent lamellæ, of a yellowish white colour, and glistening pearly lustre, consists of 48 parts of silex, 24 of alumine, 23 of lime, and 4 of oxide of iron. The prehnite is also found massive, and consists of the same elements, somewhat differing in their respective proportions, together with about 2 per cent. of water.

Crystallized prehnite has been met with in considerable quantity, and of a purer green than that of Europe, at the Cape of Good Hope ; it occurs in France ; in the valley of Fascha in the Tyrol, accompanying mesotype ; and at Dunglasse in Scotland.

The lamelliform variety, called the *Koupholite*, occurs near Barèges, and the peak of Eredlitz in the Pyrennees, in a gangue of cavernous hornstone, mingled with chlorite, &c.

The massive is found in France ; in Scotland, near Dumbarton ; at Hartfield Moor, nearly Paisley ; at Frisky Hall, near Glasgow ; at the Castle Rock, near Edinburgh ; and in the Isle of Mull.

The Prehnite seems to belong to rocks of early formation, of which it does not enter into the composition ; it is only disseminated in small quantity, without forming either beds or veins.

ZOYSITE.

The Zoysite, which, together with the Thallite, is included by Haüy under the name of EPIDOTE, was so called after the Baron de Zoys. It occurs in oblique rhomboidal prisms, of a grey, greyish or yellow or brown colour, with a pearly lustre and translucent, which are rarely perfect, owing to deep longitudinal striæ. The Zoysite consists of 44 parts of silex, 32 of alumine, 20 of lime, and 2.5 of oxide of iron, and is met with in Carinthia, the neighbourhood of Salzburg, and in the Tyrol, &c.

IDOCRASE. VESUVIAN. BROWN VOLCANIC HYACINTH.

Idocrase occurs massive, but more often crystallized in groups, consisting of short quadrangular prisms, of which the edges are variously replaced, and variously terminated. Haüy notices eight varieties in the form of its crystals; one of which, if complete, would have presented 90 planes; 16 on the prism, and 37 on each summit; he considers the primitive to be a right prism, with square bases, differing very little from the proportions of the cube. The colour of the Idocrase is mostly brownish or yellowish green, sometimes orange, with a resinous lustre; and it is hard enough to scratch glass. That of Vesuvius consists of silex 35.50, alumine 33, lime 22.25, and oxide of iron 7.50. Its specific gravity varies from 3.088 to 3.409. It possesses double refraction.

It has been met with both in volcanic, and in primitive countries. It occurs in the midst of the projected masses of Vesuvius and Etna; where its crystals, which exhibit no appearance of change by heat, line the cavities of volcanic rocks, principally composed of felspar, mica, talc, and carbonated lime; and are accompanied by garnet, hornblende, meionite, &c.

The Idocrase has also been found in Siberia, in a greenish white serpentine, near the lake Achtaragda, and on the banks of Vilhoui; and in massive veins passing through green serpentine, in the plain of Mussa in Piedmont. It has been found also in the counties of Wicklow and Donegal, in Ireland.

It is cut and polished by the lapidaries of Naples, under the name *Crysolite of Vesuvius.*

GARNET.[*]

The Garnet is a reddish, yellowish, greenish, or blackish brown colour ; it is found in small granular masses, and crystallized in the form of the dodecahedron with rhomboidal planes, which is considered to be the form of its primitive crystal. It also occurs in crystals having 24 trapezoidal faces ; only 5 or 6 varieties have been described. It is harder than quartz, but not so hard as the alamandine. It is rarely transparent, frequently opake. It consists of 43 parts of silex, 16 of alumine, 20 of lime, and 16 of oxide of iron.

The alamandine, allochroite, melanite, aplome and garnet, are commonly arranged together under the latter name ; but their elementary constituents do not correspond.

Garnets are very abundant ; they principally occur disseminated among some of the older rocks, as micaceous schistus, serpentine, and gneiss, and sometimes in granite. They are met with in most countries in which those rocks occur, and sometimes are so plentiful as almost to constitute the mass. They are found also in mineral veins, accompanying some of the ores of copper, lead, magnetic iron, mispickel, &c. In the mountains separating Stiria and Carinthia, they are met with upwards of 2lbs. in weight, in a bed of green talc. In Bohemia they are found of a brown colour, accompanying tin ; in Siberia of a pale green, in lithomarga ; at Topschau, in Hungary, of an emeral green, in serpentine : in Corsica, of a yellow colour; in the Grisons, &c. of an orange colour; in Cornwall, in small quantity, in argillaceous schistus: they are not uncommon in Scotland, in micaceous schistus; and are found in some parts of Ireland.

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[*] *Garnet.*—Garnets are found in the county of New York, cryſtallized in twelve ſided figures, as large as hazel-nuts. Mica is frequently aſſociated with them in theſe cryſtalline forms. They are bedded in gnieſs, micaceous ſchiſt, and granite, and are ſeparated by the cold-chiſſel. Granite is not uncommonly aſſociated with black schoerl, as in the fine rounded ſpecimens from Hurtleberry iſland. It occurs in conjunction with quartz. Mica is often blended with garnet. Indeed garnet mingles abundantly with the ingredients of gnieſs, granite, and micaceous ſchiſt, in binary, ternary, and quarternary forms.

I have beautiful ſpecimens of dodecahedral garnets, of nearly the ſize of peas, from Norway ; and ſome have very large and complete ones from the North-weſt coaſt of America.

Is ſometimes maſſive, and ſometimes its grains are compacted into garnet-rock.

CINNAMON-STONE.

This rare mineral has only been met with at Columbo, in the island of Ceylon. It is known in Holland by the name of Kanelstien, signifying cinnamon-stone, probably from its resemblance to cinnamon in colour. Its geological situation is not known. It occurs massive, or in detached fragments, which are full of cracks, and usually of a yellowish brown, passing into orange yellow and hyacinth red. It is somewhat transparent, with a vitreous-resinous lustre, and scratches quartz, though with some difficulty. By analysis it affords 38.8 of silex, 25.2 of alumine, 31.25 of lime, and 6.5 of oxide of iron. Its sp. gr. is 3.6. By some, it is considered as bearing considerable affinity to the Garnet.

TRIPOLI.

Tripoli obtained its appelation from being first brought from a place of that name in Africa: it has since been found in other places. This mineral has generally an argillaceous aspect. It is sometimes of a schistose structure, but is more often massive, with a coarse, dull, earthy fracture; and is meagre and rough to the touch, and yeilds easily to the nail. It occurs of various shades of grey, yellow, and red; and is said constantly to yield 90 parts of silex, the rest being argil, iron, and sometimes a small portion of lime.

Tripoli is found in beds at Menat near Resin, in the Puy de Dome; in Tuscany, it is met with at Volterra, so situated, as to seem the consequence of the decomposition of chalcedony; and at Post-Chappel in Saxony, in a mountain containing coal. It is also found in Flanders, Westphalia, and Russia.

It is used in polishing metals, marble, glass, and other hard bodies.

BOLE. *

Bole or *Ochre* is always somewhat compact; it is either red, yellow, or brown: it yields to the nail, adheres to the tongue, and gives a shining streak on paper:—when breathed on, it gives out a sensible argillaceous odour; it breaks down in water, with which it may be reduced to the consistence of a paste.

Red Chalk or *Reddle* is by some considered as a variety of bole; but from its containing a large proportion of iron, it has lately been placed among its ores.

A variety, of a lighter colour than red chalk, is bro't from Armenia, and is commonly known by the name of *Bole armenic.*

Another variety, found in Lemnos, when impressed by the seal of the governor of the island, or of the Grand Seignor, is sold under the name of *terra sigillata.* It is used in medicine. *Red* bole is found near Estremos in Portugal.

Bole of a *yellow* colour occurs in beds, between those of sand, and therefore belongs to the newest secondary formation. It becomes red by exposure to heat. It is met with at several places in France; that of Auxerre is composed of 65 of silex, 9 of alumine, 5 of lime, and 20 of oxide of iron.

The red brown earth of Sienna, used as a pigment, is considered to be a variety of bole.

Bole of a *brown* colour, or of a yellowish [illegible]wn, is commonly known as a pigment, by the nam[illegible] *bistre*; it is found in the island of Cyprus, but nothing is known of its geological situation. It is used in porcelain painting.

Boles are considered as coloured marles or clays.

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* *Bole.*—Ochres of various hues are found in the United States. New-York, New-Jerſey, Delaware, and Louiſiana, have furniſhed yellow ochres, red ochres, brown ochres, of many ſhades and hues, and which mix well with oil into paints.

CLAY

The substances comprehended under the term of Clay, may be generally described as any earthy mixture which possesses plasticity and ductility when kneaded up with water. Few, if any of the substances possessing these characters, can, strictly speaking, be considered as constituting a distinct mineral species; being, in general, the result of the decomposition of rocks. Clay, when moist, is plastic; somewhat unctuous to the touch, and acquires a polish by being rubbed with the finger or the nail; when dry, it is solid; when burnt, sufficiently hard to give sparks with the steel, and is infusible. Clays, generally speaking, have not been analyzed; though it is suspected that the proportions of their constituent principles vary considerably. They are considered in the aggregate to consist of a large proportion of silex, mixed with a third or fourth of their weight of alumine, occasionally with a small quantity of lime, a variable proportion of oxide of iron, and some water.

In the term Earthy Clay, may be comprehended common brick earth, or loam, and common alluvial clay.

Brick earth or *Loam* varies very much in appearance, texture, and composition. It usually contains a considerable proportion of sand; which, nevertheless, is frequently added by the brick-maker. It is commonly met with above common alluvial clay, and frequently rests upon an interposed bed of sand. The organic remains contained in it are few.

Common alluvial Clay occurs principally in low countries, in which it serves to fill up hollows; it frequently rises into hills, which sometimes are stratified. In many countries considerable tracts consist principally of clay to a great depth, as in the London chalk basin, which has been perforated in some places to the depth of 500 feet, without passing through it; it contains the remains of large land and sea animals, and sometimes vegetable remains are found in the same bed; occasionally at various depth, beds of fine white sand are met with. Deposites or beds of clay are considered to consist of the debris or ruin of rocks, and are regarded among the principal causes of the formation and duration of springs. The water which percolates the secondary country, bordering the deposites of clay, passes beneath them, and is retained untill some opening permits it to rise in the shape of a spring, or until vent is given to these reservoirs by the sinking of wells.

Pipe Clay[*] is of a greyish or yellowish white colour, an earthy fracture, and smooth greasy feel; it adheres pretty strongly to the tongue, and is very plastic and tenacious. It is manufactured into tobacco pipes, and is the basis of the Queen's ware pottery.

Potters' Clay[†] is plastic, slaty. It yields to the nail; is generally of a reddish, bluish or greenish colour, and has a soft and often greasy feel. When mixed with sand, it is made into bricks and tiles. A variety found in the forest of Dreux, in France, employed, on account of its infusibility, in the making of tiles for the porcelain furnaces, consists of 43 parts of silex, 33 of alumine, 3 of lime, 1 of iron, and 18 of water. Most part of the clay used in the potteries of Staffordshire and Newcastle upon Tyne, is said to be found near Teignmouth in Devonshire. That of Hampshire yields by analysis, 51 parts of silex, 25 of alumine, 3 of lime, with a trace of manganese and some water.

Porcelain clay[‡] is greyish or yellowish-white, or more often reddish-white; it adheres to the tongue, is meagre to the feel, and is commonly friable; but if compact, is easily broken. It falls to pieces in water and becomes plastic, though not in a very great degree. That which is found in considerable beds in the parish of St. Stephen's in Cornwall, consists, according to Wedgwood, of 60 parts of alumine and 40 of silex. It seems undoubtedly to originate from the decomposition of felspar; it frequently contains portions of quartz and of mica. The origin of porcelain clay, in the general, is not however well understood. It differs materially in respect of composition. The *Kaolin* of China consists of 71.15 of silex, 15.86 of alumine, 1.92 of lime, and 6.73 of water. It is found largely in France, and granitic countries, and therefore seems to have the same origin as that of Cornwall.

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[*] *Pipe Clay.* Pipes for ſmoking have been made of a kind of Clay in the town of Oyſterbay, Long Iſland. The pipes, however, were deficient in ſolidity and ſtrength.

[†] *Potter's Clay.* (ibid.) Clay, for earthen ware and ſtone ware, abounds in a great number of places.

[‡] *Porcelain Clay.* The experiments made in the city of New-York, prove that porcelain clay is found in this country. Elegant pieces of porcelain, equal to the Chineſe, or even the French, have been made from domeſtic materials.

Indurated clay is met with interposed between beds of coal at Stourbridge in Worcestershire, and at Coalbrook Dale in Shropshire. It is sometimes called *Stourbridge clay* or *fire clay.* It occurs massive, and in large compressed nodules of a greyish white colour, with a tinge of blue or yellow; it yields readily to the knife, and is very refractory in the fire; by exposure to the air it becomes soft and falls to pieces, and then becomes plastic.

PORCELLANITE.

Porcellanite is found massive, and of a slaty structure. Its colour varies from grey to bluish grey, mixed with red; ochry yellow; greyish or bluish-black. It is opake, and hard enough to scratch glass; but it is not abundant; being principally, if not exclusively found in places in which mines of coal have been in a state of combustion; and is regarded as shale altered by heat. At Mount Brussant, near St. Etienne, in France, it is composed of layers, alternately grey and red; that of Schlangenberg, in Bohemia, is of a dull green colour.

MELANITE.*

The Melanite is usually black and opake, and occurs in the form of a rhomboidal dodecahedron, of which the edges are commonly replaced by planes. It consists of about 35 parts of silex, 6 of alumine, 32 of lime, 25 of oxide of iron, and a trace of oxide of manganese. The Melanite is usually arranged among garnets. It has been found in Italy, at Frascati, near Vesuvius, in a volcanic rock, enclosing also felspar, idocrase and hornblende: it also occurs in the calcareous rocks of Somma.

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* *Melanite.* At Germantown it has been found of a velvet black colour, of conſiderable luſtre, varying from the ſize of a pin-head to an inch in diameter. The cryſtals are polyhedrons, with twenty-four trapezoidal faces: ſpecific gravity 3.616. It reſts in the gneiss, which repoſes on granite, of which the feldſpath is ſnow white, and has a high degree of tranſparency. Though cryſtals of tourmaline, mica, phoſphate of lime, and beryl, are univerſally diſſeminated, there is no melanite, except in this one particular place.—*Wistar, Am. Min. Jour. p.* 31.

APLOME.

The Aplome is usually considered a variety of the garnet, with which it agrees in respect of its external figure, but differs in containing manganese. It commonly occurs in rhomboidal dodecahedrons, of which the planes are striated parallel with their lesser diagonal; they are usually of a deep brown, or orange-brown colour, opake, and somewhat harder than quartz; it consists of 40 of silex, 20 of alumine, 14.5 of lime, 14.5 of oxide of iron, and 2 of oxide of manganese. The aplome is found on the banks of the river Lena in Siberia. Garnets of a yellowish-green colour have been met with at Swartzenberg, in Saxony, which have considerable affinity to this mineral.

THALLITE. ACANTICONITE.

This mineral is found granular, massive, or crystallized in six, eight, or twelve sided prisms, variously terminated and longitudinally striated; and is of a green, yellowish, bluish, or blackish-green colour, of a shining lustre, and somewhat transparent. The primitive crystal is a right prism, of which the bases are oblique-angled parallelograms. Haüy includes this mineral and the zoisite under the term *epidote* The crytallized thallite consists of 37 parts of silex, 21 of alumine, 15 of lime, 24 of oxide of iron, and 1.5 of oxide of manganese; and its specific gravity is 3.45: but the granular variety, in the form of a green sand, varies in respect of the proportions of its elements.

The Thallite is not often found massive, but chiefly in crystals, varying in size from the acicular to near an inch in diameter; the acicular are met with in the department of Iseré, in France; at Chamouni, in the Alps, &c.; the larger occur at Arendahl, in Norway. It belongs exclusively to primitive rocks, but is only found in veins and fissures; magnetic iron, garnet, felspar, adularia, axinite, and asbestus, are the minerals which chiefly accompany thallite.

WERNERITE.

This mineral is of a greenish-grey or olive-green colour, with a lustre between pearly and resinous; it is softer than felspar, and yields to the knife. It occurs massive, and in eight-sided prisms with four-sided pyramids. It consist of 40 parts of silex, 34 of alumine, 16 of lime, 8 of oxide of iron, and 1.5 of oxide of manganese.

The wernerite is a rare mineral; it is met with in irregular grains or crytallized, disseminated in rocks composed of a greyish or of a red felspar, intermingled with quartz, at Bouoen, near Arendahl in Norway; in the mines of Nortbo and of Ulrica in Sweden, and at Campo-longo in Switzerland.

TOURMALINE.[*]

Tourmaline in respect of colour, is either white, green, blue, brown, yellow or black; it occurs in crystals which are striated, or rather deeply channelled, lengthwise; their lustre is splendent or vitreous, and they are scarcely so hard as quartz. It is remarkable that this substance is either translucent or transparent when held

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[*] *Tourmaline.* Very large cryſtals of black tourmaline have been found in the primitive and granitical rocks, near New-York, Philadelphia, and Brunſwick in Maine. Indigo tourmalines of nearly an inch in diameter have been brought from Northampton, Maſs. They are of a deep indigo blue, almoſt approaching to black. They are bedded in granite, with quartz, feldſpath and reddiſh mica, of remarkably coarſe and diſtinct parts. Green tourmalines are found with them, in long cryſtals.

Red Schoerls, or Rubellites, accompany the green ſchoerls. The latter have been ſeen to reſemble a tube or canal filled up by the former. Such up to the light, and viewed in a direction perpendicular to the axis of the prism; but if viewed perpendicular to the bases, is always opake, even though the prism be short. Seventeen varieties in the form of the crystal have been described; their primitive form is, according to Haüy, an obtuse rhomboid of 133°. 26′ and 46°. 34′. The crystals become electric by being heated, and thereby acquire polarity; and their summits or pyramids are always dissimilar. That which presents the greatest number of faces always exhibits the positive or vitreous electricity; and that having the smaller number, always the negative, or resinous. Its specific gravity is about 3.

The green tourmaline of Brazil is composed of 40 parts of silex, 39 of alumine, 3.84 of lime, 12.5 of oxide of iron, and 2 of oxide of manganese.

The white variety was found at St. Gothard in micaceous dolamite by Dolomieu, who mentions having discovered some in the granite of Elba, the half of which was white, the other half black. The yellow variety has been noticed in sand from Ceylon. Tourmalines of a dull green, or of a bluish-green, are from Brazil; those of an emerald-green, from Ceylon. A variety of an indigo-blue-colour, thence called *Indicolite*, has been found in the mine of Utoe in Sweden, in crystals of an indeterminate form, disseminated in a gangue of steatite, quartz, and felspar.

AXINITE. THUMERSTONE.

This mineral derived its name of Thumerstone, from having been first met with at Thum in Saxony. It occurs in lamelliform concretions, and crystallized. The

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maſſes of red ſchoerl, incaſed by green, have a peculiar and beautiful effect. Sometimes the red incloſes the green. Theſe ſingular forms led Dr. Bruce to ſend ſpecimens to Profeſſor Haüy, who has thought them worthy of a ſpecial diſſertation. This intereſting tract has been tranſlated by Dr. P. S. Townſend, for the New-York Lyceum of Natural History, and publiſhed in Meſſrs. Biglow & Holley's Magazine. I own my obligations, for a ſet of very fine ſpecimens, to Ezra Weeks, Eſq. The Rev. Mr. Schaeffer and other gentlemen brought curious ſpecimens of a fine needle-like indicolite, from a detached rock in the city of New-York. In theſe pieces, green often accompanied the blue.

lamelliform, of a dingy violet colour, is found at Ehrenfriedersdorf in Saxony. The same variety, of a dull clove-brown, is found at Botallack, near the Land's End in Cornwall; sometimes also it is crystallized, though not very determinately. The most beautiful is met with in a serpentine rock at Balme d'Auris in Dauphiné; generally in neat and well defined crystals, sometimes nearly colourless and transparent, but more often of a dull reddish violet colour and translucent; whence it has obtained the name of *Violet Schorl of Dauphiné*. The crystals in my possession exhibit 18 varieties of form, which are not symmetrical. This want of symmetry is common to those substances, which, like the axinite, become electrical by exposure to heat. The primitive crystal of the axinite is a remarkably flat right rhomboidal prism, of which the bases are oblique angled parallelograms of 78°½ and 101°½ according to Haüy; but the measurements obtained by the reflecting goniometer do not correspond with the results obtained by him. The axinite is hard enough to scratch glass, but less hard than quartz; its specific gravity is about 3.2; and it consists of 44 of silex, 18 of alumine, 19 of lime, 14 of oxide of iron, and 4 of oxide of manganese.

It has only been met with in veins and fissures of primitive rocks, and is not very abundant. Besides the places above mentioned, it occurs in the peak of Eredlitz in the Pyrennees, upon a gangue of quartz, accompanied by carbonate of lime; near Alençon in granite; at Mount Atlas, in Africa; near Kongsberg in Norway, in a white laminated calcareous rock, accompanied by black mica, quartz, and sometimes native silver.

ALLOCHROITE.

The Allochroite, is of a greyish, dingy yellow, or reddish colour, and opake; it is not so hard as quartz. It consists of 35 parts of silex, 8 of alumine, 30.5 of lime, 17 of oxide of iron, 3.5 of oxide of manganese, and 6 of carbonate of lime. It is commonly considered as a variety of the garnet, from which it differs in respect of composition.

The Allochroite is found in the iron mine of Virums, near Drammen in Norway, accompanied by carbonate of lime, Hematites iron, and brown garnets.

LAPIS LAZULI.

This mineral is found massive, and of a fine azure blue colour; its texture is fine grained or compact, and it is hard enough to scratch glass, though it scarcely gives sparks by the steel. Its specific gravity is 2.76 to 2.94. Its blue colour is not uniform, as it frequently encloses iron pyrites, compact felspar, and quartz. It is said to have been met with crystallized in the form of a rhomboidal dodecahedron; but as the crystal was opake, and enclosed iron pyrites and carbonate of lime, there seems no sufficient proof of its being true Lapis Lazuli; which according to Klaproth, consists of 46 of silex, 14 of alumine, 28 of carbonate of lime, 6.5 of sulphate of lime, 3 of oxide of iron, and 2 of water.

It has been found in small masses enclosed in primitive rocks, principally in granites, accompanied by felspar, pyrites, garnet and carbonate of lime; but is more often found in small masses rounded by attrition; as on the borders of the lake Baikal in Siberia. The finest specimens are brought from China, Persia, and Great Bucharia.

Lapis lazuli is used in jewellery, but is chiefly important as affording that beautiful pigment called ultramarine, so highly valued by painters on account of its great advantage of not changing by time and exposure.

EGYPTIAN JASPER.

This mineral is more commonly known by the name of *Egyptian Pebble.* It occurs in roundish masses which are externally rough, and generally of a brown colour. Internally it is usually of a light colour, which sometimes approaches to that of cream, around which are disposed irregular zones or bands of various shades of brown, sometimes intermixed with nearly black spots, and occasionally dendritic appearances. Its specific gravity is

2.5—2.6; by one analysis which does seem to have been complete, it yielded 75 parts of silex, 15 of alumine and 5 of magnesia.

It is found according to Dr. Clarke, in vast abundance, together with masses and detached fragments of petrified wood, among which are several varieties of the palm, scattered over the surface of the sandy desert, eastward of Grand Cairo, even to the borders of the Red Sea.

It is susceptible of a high polish, and is therefore often applied to ornamental purposes.

TREMOLITE.

The general colour of Tremolite is white, which sometimes has a greenish, bluish, yellowish or reddish tinge; it occurs fibrous, and crystalized in four, six, or eight-sided prisms, terminated by diedral summits, and is semi-transparent or translucent, and hard enough to scratch glass. Its specific gravity is about 3; the fibrous variety of Clicker Tor in Cornwall is composed of 62.2 of silex, 14.1 of lime, 12.9 of magnesia, 5.9 of oxide of iron, and 1 of water.

It was first discovered in the valley of Tremola near St Gothard, whence its name; it has since been met with in Hungary, Transylvania and Bohemia. In Corsica, it occurs in lamellar bluish green talc; near Nantes, in granite abounding in felspar: at Somma, in granular carbonate of lime; and in Bengal: in lamellar limestone, in the banks of the lake Baikal in Siberia, whence it has been called *Baikalite;* in Glen Tilt and Glen Egg in Aberdeenshire, in white primitive limestone; in Cornwall, it is found at Clicker Tor. A fibrous specimen in my possession from Stony Gwins in that county, is deposited on quartz, and accompanied by small yellow crystals of uranite.

MEERSCHAUM.

Meerschaum is of a whitish or yellowish white colour, opake and dull; it has an earthy fracture, yields easily to the nail, and adheres strongly to the tongue; sometimes it is so light as to swim on water, and occasionally is very porous: this last characteristic has doubtless occasioned its name, which signifies sea-foam. It consists of 50.5 per cent. of silex, 17.25 of magnesia, 0.5 of lime, 5 of carbonic acid, and 25 of water.

It occurs in the isle of Samos and Negropont in the Archipelago, in mass, or disseminated, or in beds: at Kiltschik in Natolia, it fills a vein about six feet wide, traversing compact grey carbonate of lime; it is soft when first dug, and in that state is made into pipes, but hardens by exposure to air. It is also met with in Carinthia.

In the Turkish dominions, Meerschaum is employed as fuller's earth is with us; and by the women as soap for washing their hair. In Constantinople it is termed Keffekil or earth of Kaffa, the town of the Crimea. whence it is shipped.

A substance somewhat similar to Meerschaum has been found at Cartel del Piano near Sienna, consisting of 55 of silex, 25 of magnesia, 12 of alumine, 3 of lime, and 0.1 of oxide of iron; it was made into bricks so light as to swim on water, thus restoring one of the lost arts recorded by Strabo and Pliny.

Another substance, consisting of 55 of silex, 22 of magnesia, and 23 of water, and of a chocolate brown colour, is found at Salinelle near Sommières, in beds, in chalk containing silex: and in various places in Piedmont, a substance of a white colour, consisting, when fresh dug, of silex, magnesia, and water, is found in beds and in veins: by exposure to air it absorbs carbonic acid.

ANTHOPHYLLITE.

The Anthophyllite has hitherto only been found at Kongsberg in Norway; it occurs massive, with joints parallel to the faces of a rectangular prism, is feebly translucent on the edges, and has a slight metallic lustre; it is scarcely hard enough to scratch glass. Its specific gravity is about 3.3. By analysis it is found to consist of 62.66 of silex, 13.33 of alumine, 4 of magnesia, 12 of oxide of iron, 3.25 of oxide of manganese, and 1.43 of water.

Some of the characters of the Anthophyllite have induced Haüy to suppose that it is only a variety of the Hypersthene; but their elements do not correspond.

HARMOTOME. CROSS STONE.

The harmotome is commonly met with in flattish quadrangular prisms, terminated by four rhombic planes, crossing each other lengthwise and at right angles. It is also met with in solitary crystals. Their primitive form, according to Haüy, is a rectangular octohedron of 86° 36′ and 93° 24′; but this is not confirmed by the reflecting goniometer, which gives results differing about 2°. I possess crystals of the harmotome in 12 varieties of form, one of which is so remote from the primitive, as to appear a perfect six-sided prism, and several approach that form. This transition is very intelligible, though not easily described without figures.

In cruciform crystals it occurs in metalliferous veins, mingled with white lamellar carbonate of lime and sulphuret of lead, at Andreasberg in the Hartz; it is also met with at Strontian in Scotland. In solitary crystals it is chiefly found in the cavities of siliceous geodes at Oberstein in Saxony.

The colour of this mineral is greyish-white; it is translucent with a somewhat pearly lustre, and is hard enough to scratch glass. Its specific gravity is 2.35; and it is composed of 49 per cent of silex, 16 of alumine, 18 of barytes, and 15 of water.

ASBESTUS.*

There are several varieties of asbestus. They are generally of a fibrous texture, varying in respect of flexibility and elasticity. The fibres of asbestus have not yet been seen in any very determinate form, but Haüy regarded some which fell under his observation as rhomboidal prisms. Asbestus is extremely difficult of fusion in the mass; but its fibres are easily reduced by the blowpipe. Asbestus is derived from a Greek word, sigfying imperishable.

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* *Asbestus.*—Aſbeſtus with rigid fibres is often found in the city of New-York, in detached maſſes; miſtaken by many for petrified wood. It is alſo brought from Hoboken, where it fills the veins of ſerpentine; and from Staten-iſland, where it accompanies ſteatites.

*Amianthus** occurs in very long and extremely slender fibres, which are very flexible, and of a whitish, greenish or reddish colour. It consists of 59 per cent. of silex, 3 of alumine, 9 of lime, and 29 of magnesia.

It is found in the Tarentaise in Savoy, in the longest and most beautiful fibres: that of Corsica is less beautiful, but is so abundant, that Dolomieu used it for packing his minerals: near Barèges in the Pyrennees, it occurs mingled with felspar, lining veins passing through gneiss. It occurs also at Inverary at Portsoy in Scotland, and in the Isle of Unst.

Amianthus (signifying unsoiled) was woven by the ancients into a kind of cloth, in which, being incombustible, they wrapped up the bodies of their dead, before they were placed on the funeral pile, that their ashes might be collected free from admixture.

Mountain Cork. The structure of this variety differs from the former; the filaments are not deposited in a parallel direction, but intermingled in various directions, occasioning cavities, to which may be attributed the lightness of the mass. When in thin flexible plates, it is termed *mountain leather;* when in thin and less flexible, *mountain cork.*

It occurs in the silver mines of Johan Georgenstadt in Saxony; at Bleyberg in Carinthia; at Idria; at Salberg, &c. in Sweden; between the villages of Randagont and Vigan near Alais in France, it is spread over the soil, which consists of an ochreous earth mingled with quartz and mica, in long white pieces, which have been taken for human bones. It is also met with at Kildrummie and at Portsoy in Scotland.

Mountain wood or *Ligniform asbestus* has somewhat the appearance of wood; its structure is finely foliated, the foliæ being composed of fine fibres, which are of a brownish colour. It is opake, somewhat elastic, and floats on water. It is principally met with in the primitive mountains of the Tyrol, accompanied with amianthus. It also occurs in various places in Scotland.

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* *Amianthus* is found in many parts of the United States, in the veins and fiſſures of primitive rocks. The fibres are sometimes ten or twelve inches long, and, by their whiteness, parallelism and flexibility, reſemble flax. The mountains along the confines of New-York and Connecticut, contain many varieties. At Staten Iſland the fibres are nearly two feet long, and twiſt like hemp.

The forms of Asbestus, called *Thrum-stone*, *Leather-stone*, *Mineral Cotton*, *Salamander's Wool*, are all contained in the primitive formation of New-York, and its vicinity.

Common asbestus is much heavier than the preceding varieties, being nearly three times the weight of water. It occurs in masses consisting of fibres of a dull greenish colour, and pearly lustre. Common asbestus is scarcely flexible. It is of more frequent occurrence than amianthus: it usually accompanies serpentine; and is met with in Sweden, Hungary, Dauphiné, the Uralian mountains, at Portsoy in Scotland, the Isle of Anglesey, and at the Lizard in Cornwall.

BASALTIC HORNBLENDE.

Basaltic hornblende is usually met with in opake single crystals, imbedded in basalt or in lava; the latter sometimes affect the magnetic needle. The usual colour of this mineral is black; or brownish black, occasioned by a slight decomposition. The crystals are six-sided, variously terminated by three or four planes; but they are sometimes dissimilar at the two extremities: their primitive form, according to Haüy, is an oblique rhomboidal prism of 124° 34′ and 55° 26′: the crystals have a vitreous lustre and are hard enough to scratch glass. The specific gravity of this mineral is 3.25; and it is composed of 47 per cent. of silex, 26 of alumine, 8 of lime, 2 of magnesia, and 15 of oxide of iron.

Being far less decomposable than basalt, it is sometimes found in fine crystals in the clay resulting from the decomposition of basaltic rocks. It occurs in Saxony, Bohemia, Italy, Scotland, &c.

HYPERSTHENE.

The Hypersthene is met with either massive, or imbedded in rocks in rhomboidal prisms of about 120° and 60°. Its colour is dark brown, or greenish black; it has a lamellar structure parallel with the sides of the prism, and when fractured exhibits reflections which are strongly metallic, and sometimes greenish, sometimes of a copper red colour; it is opake and yields to the knife. Its specific gravity is 3.38; and it consists of 54.25 of silex, 2.25 of alumine, 1.5 of lime, 14 of magnesia, 24.5 of oxide of iron, and 1 of water.

It usually occurs in serpentine; and is thus found in Cornwall associated with compact felspar; it is likewise found at the Col de Cervière in the Alps, at Matray in the Tyrol, at Basta in the duchy of Wolfenbuttel, and in Hungary, &c.

It is very nearly allied to the following substance.

SCHILLER SPAR.

Schiller Spar, like the preceding mineral, is always found in serpentine, in which it generally occurs disseminated. It is of an olive, or bottle-green colour, and when held in certain directions, has a shining lustre, nearly approaching that of some of the metals: it is opake and yields to the knife. A principal difference between the schiller spar and hypersthene is, that the former fuses, though with some difficulty, into a black enamel; the latter is infusible. By one analysis it yields 41 of silex, 3 of alumine, 1 of lime, 29 of magnesia, 14 of oxide of iron, and 10 of water.

It is met with in the serpentine of Cornwall and of Anglesey, and generally speaking, wherever the hypersthene is found.

AUGITE. PYROXENE.

Augite usually occurs in translucent six-sided crytals, terminated by dihedral summits; they are of a blackish-green colour, variously mixed with brown; it is also met with in angular and rounded pieces. The form of the primitive crystal is an oblique rhomboidal prism of 87° 42′ and 92° 18′. It scratches glass with ease. Its specific gravity is about 3.3; and it is composed of 52 of silex, 3.3 of alumine, 13.2 of lime, 10 of magnesia, 14.6 of oxide of iron, and 2 of oxide of manganese.

Augite is met with in the productions of volcanoes; but whether it existed in certain rocks, previously to their being subjected to volcanic action, or whether it has been formed in the lavas and scoriaceous matters in which it is found, since their ejection, is matter of uncertainty and dispute. The greater number of mineralogists incline to the former opinion.

It is found in the volcanic countries of Vesuvius, Etna, Stromboli, Auvergne, &c.

It is also said to occur in the basalts of Bohemia, Hungary, Transylvania, Hessia, and in the iron mines of Arendahl, in Norway. The crystals met with in basalt are larger, of a finer green, and more brilliant than those found in lavas.

The coccolite and sahlite are regarded as varieties of augite

The *coccolite* is of various shades of green, and occurs in little round translucent masses, or in grains of irregular shapes, which are very slightly coherent, but are hard enough to scratch glass: the structure is lamellar, and the lustre vitreous. It consists of 50 per cent. of silex, 1.5 of alumine, 24 of lime, 10 of magnesia, 7 of oxide of iron, and 3 of oxide of manganese.

It is said to have been met with only in primitive countries; in certain veins near Arendahl, in Norway, and Nericia in Sweden; and in the iron mines of Hellesta and Assebo, in Sudermania.

The *sahlite* occurs in crystals of which the prisms are four or eight-sided, and the summits diedral, and which are of a greenish grey colour, and scarcely hard enough to scratch glass; they are translucent on the edges. The sahlite is composed of 53 of silex, 3 of alumine, 20 of lime, 19 of magnesia, and 4 of oxide of iron and manganese.

It has been found in the silver mine of Sahla (whence its name) in Westmania, in Sweden, and at Buoen, near Auen, in Norway. It has also been met with in the mountain of Odon-Tchelon, in Siberia, accompanied by mica, beryl, and crystallized phosphorescent carbonate of lime.

PYROPE.

The Pyrope occurs in round or angular grains, of a blood-red colour, which is sometimes clouded with yellow; it never is found crystallized. It is transparent, has a conchoidal fracture, and vitreous lustre, and is hard enough to scratch glass. Its specific gravity is about 3.8, and it is composed of 40 per cent. of silex, 28.5 of alumine, 3.5 of lime, 10 of magnesia, and 16.75 of oxide of iron and manganese. It is sometimes, from its general colour, ranked among garnets; from which it essentially differs in respect to form and composition

It occurs imbedded in serpentine at Zeoblitz, in Saxony, and in wacke, in Bohemia; but is more common in the latter country in alluvial deposites, accompanied by hyacinths and sapphires. It is met with in the sand of the sea-shore at Ely, in Fifeshire, and in Cumberland, in clay-stone.

Pliny and Ovid mention a stone by the name of Pyrope, which is supposed to be nearly allied to this mineral.

POTSTONE.[*]

This substance is found massive; such is its structure, that it is sometimes difficult to distinguish it from massive talc; its colour is greenish grey, passing into leek-green, with a glistening or pearly lustre; it is so soft as to yield to the nail, and is unctuous to the touch, but is not easily broken; that of Chiavenna consists of about 38 parts of silex, 7 of alumine, 35 of magnesia, 15 of iron, together with very small portions of lime and fluoric acid.

Potstone is plentifully found at Chiavenna, in the Valteline; at Coma, in Lombardy; and, generally speaking, in serpentine countries. Its infusibility, joined to its softness, and the readiness with which it is turned by the lathe, have for time immemorial caused it to be formed into vessels in the Valais and Grisons. Pliny describes its having been used in like manner in his time.

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[*] *Potstone* is brought from Connecticut, in the form of ink-stands, well turned in a lathe.

SMARAGDITE.

The Smaragdite is of a brilliant green colour, of a silky or pearly lustre, and transparent at the edges, or opake: it is scarcely so hard as glass, and yields to the knife; its specific gravity is 3; and it is composed of 50 of silex, 21 of alumine, 13 of lime, 3 of magnesia; the remainder being oxide of chrome and oxide of iron.

It is commonly found massive, or disseminated in rounded masses of the Saussurite, on the banks of the Lake of Geneva; near Turin it occurs at the foot of the mountain Mussinet; in Corsica imbedded in felspar.

ACTINOLITE.[*]

This mineral is of a pale or of an emerald-green colour, and occurs in single crystals, but more often in masses consisting of diverging hexahedral prisms, which, in the general, are not regularly terminated; they have a shining pearly lustre, and are translucent or transparent; it also occurs in fine fibres, having a silky lustre Actinolite is hard enough to scratch glass; its specific gravity is about 3.3; and it is composed of about 50 per cent. of silex, 0.75 of alumine, 9.75 of lime, 19.25 of magnesia, 11 of oxide of iron, 5 of oxide of chrome, and 3 of water. The fibrous variety is distinguishable from Amianthus by its being extremely brittle.

Actinolite is found only in some of the primitive rocks, and accompanies talc and mica. It is not found in secondary rocks, or in the veins that traverse them.

It occurs in long six-sided prisms imbedded in white talc, at Zillerthal, in the Tyrol, and in Mount St. Gothard; it is also met with near Salzburg, in Saxony; in Norway; in Piedmont, &c.

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[*] Beautiful green crystals of *Actinolite*, from one to two inches long, are found at New-York, shooting through rocks of indurated ſteatite and ſtellated asbestus.—*Pierce.*

COLOPHONITE.

This mineral is of a blackish or yellowish brown, or of an orange red colour; and is, both on the surface and when fractured, of a shining vitreous lustre. It is usually ranked as a variety of garnet, but differs from it in yielding by analysis both magnesia and oxide of titanium, and in being much lighter: its specific gravity is only 2.5; and it is composed of 35 per cent. of silex, 15 of alumine, 2.9 of lime, 6.5 of magnesia, 7.5 of oxide of iron, 4,75 of oxide of manganese, and 0.5 of oxide of titanium. It is found near Pitigliano, in Italy.

LEUCITE.

The Leucite occurs in crystals, whose planes are 24 equal and similar trapeziums: by mechanical means it may be reduced either to the rhomboidal dodecahedron, or the cube; the latter of which, being the most simple of the two, is considered to be the form of the primitive crystal. The Leucite is generally of a dirty white colour, and is somewhat translucent; it scratches glass with difficulty; its fracture is imperfectly conchoidal, and has mostly a vitreous lustre. It consists of 53.75 of silex, 24.62 of alumine, and 21.35 of potash. Its specific gravity is 2.37.

The Leucite is most commonly found among the productions of volcanoes; that which occurs in lava is mostly opake and earthy, while that found in basalt is viterous. The lavas of Vesuvius, and basalts of Italy and Bohemia abound with this mineral. The road from Rome to Frascati is in many places quite covered with it.

LITHOMARGA.

Lithomarga varies in colour from white to yellow, red and brown; it is dull, yields to the nail, is unctuous to the touch, and adheres strongly to the tongue; its fracture is mostly earthy.

It is found in masses, somewhat round, in basalts and amygdaloids; and is often met with in veins passing through porphyry, gneiss, serpentine, &c. sometimes accompanies tin, mercury, and topazes. It seems therefore chiefly to belong to primitive countries; it occurs in France; at Laschitz, in Bohemia; at Planitz, near Zwickau, in Saxony, and at Steinmark. That brought from the latter place consists of about 45 parts of silex, 36 of alumine, 3 of iron, 14 of water, and a small portion of potash.

MICA.*

Mica mostly occurs crystallized in six-sided plates, or in right rhomboidal prisms of 60° and 120°, which is considered to be the form of its primitive crystal. It is easily divisible, parallel with the terminating planes, into thin laminæ, which are flexible and very elastic; this last character serves at once to distinguish mica from talc, which is not elastic.

This mineral is of various shades of white, yellow, green and brown;—It yields readily to the knife, but the edges of the laminæ will scratch glass. The mica of different countries does not perfectly agree in the respective proportions of its ingredients; that of Muscovy (called *Muscovy Glass*) consists of about 48 silex, 34 alumine, 9 Potash, 4 oxide of iron, and nearly 1 of oxide of manganese. Its sp. gr. is about 2.7.

Mica is one of the most abundant mineral substances: it is never found in beds, or in considerable isolated masses, but it enters into the composition of very many rocks, especially the oldest primitive, as granite, gneiss, micaceous schistus, &c and is often found filling up their fissures, or crystallized in the cavities of the veins which traverse them. Mica is therefore of the most ancient formation; but is also met with in the newest crystalline rocks. It also occurs in sandstones, in schists, and in the slaty sandstone that accompanies the independent coal formation. It is sometimes abundant in sands, and in alluvial deposites very distant from primitive mountains; and is said to be very plentiful in certain volcanic products.

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* *Mica* is found in Maine, in plates of a foot ſquare or even more. It occurs in New-York, in ſix-ſided plates, evidently of a cryſtallized figure. It is uſually an ingredient in granite and gneiss. Sometimes, however, it occurs of the like hexagonal form in calcareous carbonates. It is ſometimes nearly as tranſparent as the beſt glaſs, and aſſumes all the dusky ſhades to a deep ſmoke-colour, without loſing its tranſparency.

I have fine roſe-coloured ſpecimens from Northampton,—(*Weeks.*)—and green ones from Brunſwick, Maine.—(*Cleaveland.*)

According to Haüy, Muscovy Glass, which occurs in plates of a yard or more in diameter, in veins of granite and of macaceous schistus, in some parts of Russia, may be divided into plates no thicker than $\frac{1}{100000}$th part of an inch. It is used for inclosing objects for the solar microscope, and instead of glass in the Russian ships of war, as less liable to be broken by the concussion of the air, during the discharge of heavy artillery; an inferior kind, which is found in Pennsylvania, is used there instead of window glass.

MESOTYPE.

The Mesotype is generally of a white, or greyish colour, and is transparent, or translucent; it yields easily to the knife, and becomes electrical by heat. It occurs crystallized in radiated acicular prisms; in filaments; or in globular concretions, composed of stellated fibres. It is one of those substances which are commonly called *Zeolites.* It assumes about 10 varieties in the form of the crystal, the primitive of which is a right prism with square bases. Its specific gravity is 2; and it consists of 49 of silex, 27 of alumine, 17 of soda, and 9.5 of water, according to Simpson; but according to Vauquelin, 50.24 of silex, 29.3 of alumine, 9.46 of lime, and 10 of water.

Mesotype is found in Iceland; Scotland; the Ferroe islands; in Hessia; the Isle of Bourbon, &c.

This mineral is generally considered to be of doubtful origin. It is found in lavas, but principally, if not only, in those that are ancient; and, it is said by some, only in such as have been exposed to the action of water. It is also met with in basalts; as in those of the Giant's Causeway in Ireland; and in those of the Cyclop Islands, and of the Vicentine mountains; the basalt of the two latter is surrounded and covered by the remains of sea animals. The mesotype also occurs in basalt, amygdaloid, and other trap rocks of England and Scotland, and is particularly abundant and beautiful at Talesker, in the Isle of Sky.

The *Natrolite* is composed of the same elementary substances, and very nearly in the same proportions, and is therefore considered to be merely a variety of the mesotype. It is always of a fibrous and radiated structure; and is of a whitish, yellowish, or of a brown colour. In its cavities are found crystals presenting the form of common mesotype, viz. a rectangular prism, with tetrahedral pyramids.

RUBELLITE.*

The Rubellite is of a red or violet colour, and occurs crystallized, but the crystals are rarely distinct. It is found in Moravia; in Ceylon; it occurs in a granite mountain in the Uralian chain in Siberia, in a vein composed of felspar, quartz, mica, and common schorl; whence this mineral has been also called *Siberite*. It consists of 42 per cent. of silex, 40 of alumine, 10 of soda, and 7 of oxide of manganese and iron. It is commonly considered to be a variety of tourmaline, from which it differs, in not having either lime or magnesia among its constituent elements, and in being infusible. This mineral is commonly known by the name of *Red Schorl*.

PUMICE.†

Pumice is sometimes found massive; more often it is extremely porous, of a fibrous structure, and harsh to the touch; its colour is grey, tinged with brown or yellow, and it has a shining pearly lustre; it is translucent in the edges, very light, and sometimes so light as to swim on water. It is composed of 77.5 parts of silex,

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[*] The memoir of Profeſſor Hauy already mentioned, corrects, from the examination of the American Tourmalines, ſeveral errors into which Mineralogiſts had fallen, by ſeparating Indicolite and Siberite from Tourmaline, of which they are but varieties.

[†] *Pumice-ſtone* floats down the Miſſouri. It is formed by the fire of the burning plains through which that river runs. The pieces I poſſeſs are of a reddiſh brown, or brick colour, and float in water.

17.5 of alumine, 1.75 of oxide of iron, and 3 soda and potash.

Pumice is generally believed to be a volcanic product; it sometimes accompanies obsidian; it is said that the vitreous obsidian of Hungary, may, by heat, be changed into a substance perfectly resembling pumice.

It is but sparingly found near Vesuvius, not at all near Etna. It is very abundant in the Lipari islands, which furnish the pumice of commerce. It is met with in Auvergne in France, in Iceland, Teneriffe, &c.

ICHTHYOPHTHALMITE; OR FISH-EYE-STONE.

At first sight this mineral resembles the variety of felspar called adularia, but is much softer, being easily cut by the knife; it does not scratch glass. Its general colour is white, which is sometimes tinged with red or green; it has a shining pearly lustre. The form of its primitive crystal is a rectangular parallelopiped, in which it sometimes occurs; as well as nearly in the proportions of the cube, and in flat tables. Its specific gravity is 2.46; and it is composed of 51 parts of silex, 28 of lime, 4 of potash, and 7 of water.

It is met with in the iron mine of Otoe in Sweden; its gangue is a lamellar carbonate of lime, of a red violet colour; it is accompanied by hornblende and some ores of iron. The massive occurs at Dunvegan in the Isle of Sky.

TALC.

Talc is for the most part either white, apple-green, or yellowish. It occurs in hexagonal laminæ, and massive. It always consists of plates or laminæ, which are easily separated from each other, and are flexible, but not elastic. This last character serves to distinguish this mineral from mica, which is very elastic. Talc is of a shining lustre, is very unctuous to the touch; yields easily to the nail; it leaves a white, and somewhat pearly streak, when rubbed on paper. Its specific gravity is 2.77; and it consists of 61 of silex, 30.5 of magnesia, 2.75 of potash, 2.5 of oxide of iron, and 0.5 of water.

Crystallized talc, which is mostly white, or of a light green colour, is met with in small quantities in serpentine rocks, with actinolite, carbonated lime, steatite, compact talc, &c. It is found in the mountains of Salsburg and the Tyrol, and is taken to Venice; whence it has obtained the name of *Venetian Talc.* It occurs also at Briançon; at Zœblitz in Saxony; in Silecia, &c.

Massive talc is less flexible and translucent than the crystallized; it is principally of an apple-green colour, and is sometimes of a radiated structure. It is met with in considerable beds in mountains of micaceous schistus, gneiss, and serpentine. At Grenier in the Tyrol, it occurs in a species of serpentine, accompanied by actinolite, corbonate of lime, sulphuret of iron, green mica, &c. At Zillerthal, in the Tyrol, it is met with enclosing long prisms of actinolite, and of tourmaline. It occurs also in Austria, Stiria, &c.

Talc is found in Glen Tilt, in Perthshire, in a granular limestone.

Indurated Talc, of a greenish-grey colour, and massive, is met with at the Lizard, in Cornwall, which is a serpentine country.

GREEN EARTH.

This mineral is met with in small masses, or lining the cavities of amygdaloid; and is of a greyish or bluish-green colour, passing into blackish green; it is dull, and yields to the nail; its fracture is generally earthy. It is found wherever amygdaloid occurs; as in Saxony, Bohemia, Monte Boldo, near Verona, the hill of Kinnoul near Perth in Scotland, &c. That of Verona consists of 53 of silex, 2 of magnesia, 10 of potash, 28 of oxide of iron, and 6 of water. When of a good colour it is made some use of by painters.

A substance of a green colour may be observed in little round masses in certain sand stones, as in that of the coast near Folkstone, which is, by some, considered to be a variety of green earth.

SPODUMENE. TRIPHANE.

This rare mineral is of a greenish white colour, of a shining pearly lustre, and translucent. It considerably resembles adularia, but differs essentially from it in respect of mechanical cleavage. Spodumene is divisable into prisms with rhombic bases, having alternate angles of 80° and 100°. It is hard enough to scratch glass, and to give sparks by the steel: its specific gravity is 3.192, and it is composed of 64.4 of silex, 24.4 of alumine, 3 of lime, 5 of potash, and 2.2 of oxide of iron.

It has only been found in the iron mine of Utoe, in Sweden, in a gangue of red felspar, fat quartz, and black mica.

FELSPAR.*

Felspath, in German, signifies rock-spar: feldspath, field-spar.

The general form of the crystals of felspar is an oblique prism, having very unequal planes; Haüy notices 21 varieties: the structure is lamellar, and felspar may be cleaved into an oblique angled parallelopiped, which therefore is the primitive form. The alliance of the crystals with each other is not easily traced, on account of the great difference frequently existing in the size, and consequently in the form, of its secondary planes, as well as on account of its being often in hemitrope or macled crystals; it is hard enough to scratch glass, but not so hard as quartz, and yields to the knife with some difficulty; it becomes phosphorescent by friction. There are several varieties of felspar.

Adularia, so called from its having been first met with on one of the heights of St. Gothard, called Adula, is found both massive, and crystallized; it is of a greenish white colour, but almost limpid, and has a pearly lustre; its fracture is imperfectly conchoidal. Its specific gravity is 2.54; and it consists of 64 per cent. of silex, 20 of alumine, 2 of lime, and 14 of potash. In the veins of mount St. Gothard it occurs in large and well defined crystals in gneiss and micaceous schistus; and in the mountains near Mont Blanc, in crystals much smaller and less transparent.

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* The white Feldſpar is the common ingredient in our granite-rocks, giving them their white colour. In many caſes, it is crumbling to pieces, and decompoſing the rocks to which it belongs.

Red or fleſh-coloured Feldſpar is alſo of frequent occurrence in the Fredonian granites and ſyenites, imparting to them their red complexion.

The *Moon stone*, so called from its pale white hue, is considered to be a kind of adularia; and is brought from the East, particularly from Arabia and Persia.

Common felspar occurs of a whitish, yellowish, reddish or red colour, and either granular, massive, disseminated or crystallized; it is sometimes opake, sometimes translucent; its specific gravity is 2.54, and it is composed of 62.83 parts of silex, 17.02 of alumine, 3 of lime, 13 of potash, and 1 of oxide of iron.

Common felspar is the most generally diffused, both as to its local and geological situation, of any other mineral, except quartz and oxide of iron. It is an essential constituent of granite and gneiss, and frequently occurs in micaceous and argillaceous schistus; it forms a large proportion of sienite, and is contained in almost all porphyries, in some very abundantly: it is occasionally, though rarely, found in primitive limestone: it abounds in primitive and secondary traps, and in the greater part of real lavas.

A variety of a beautiful apple *green* colour has been met with only in a hill at the eastern base of the Uralian mountains, near the fortress of Troitzk.

Felspar is occasionally met with, which is more *compact* than the common, but agreeing with it in most respects, except that its structure is less decidedly lamellar, and that its specific gravity is greater; being 2.63.

Lamellar Felspar. Petuntzé. Under these names has been described felspar in the first stage of decomposition, but preserving its lamellar character. Its ordinary colour is dirty white, and it sometimes occurs in large masses, enclosing small portions of quartz. It is chiefly employed in giving the enamel to porcelain.—The manufactories of France are chiefly supplied from the neighbourhood of Limoges. A slightly saline taste belongs to it, which also is characteristic of the petuntzé of China. The perfectly disintegrated felspar, being usually considered as one of the clays, is noticed with them under the name of *Kaolin.*

Glassy Felspar, Sanidin. This mineral is chiefly found in crystals, sometimes longitudinally striated; it occurs imbedded in porphyry-slate, in Bohemia, at Drachenfels near Born on the Rhine, at Solfatara in Italy, and in Pitchstone in the Isle of Arran. It obtained its name of Glassy, from its vitreous lustre, which sometimes approaches to pearly: it is semi-transparent and translucent, and of a greyish or yellowish white colour. Its specific gravity is 2.57; and it is composed of 68 parts of silex, 15 of alumine, 14.5 of potash, and 0.5 of oxide of iron.

Labrador Felspar. The beautiful and varied tints of this mineral, when viewed in particular directions, are well known; it has the usual characters of felspar, except that its general colour is grey, or dark ash grey; and that, by the analyses of this mineral, which are not greatly relied on, it appears that potash does not enter into its composition. Its specific gravity is 2.6.

It was first discovered by the Moravian missionaries in the island of St. Paul, on the coast of Labrador; it has since been found in Ingermannland in Norway; near the lake Baikal in Siberia; in granite near St. Petersburg; also at Memelsgrund in Bohemia, and near Halle in Saxony. It is sometimes accompanied by mica, schorl, and iron pyrites.

SCALY TALC. NACRITE.

This mineral occurs in minute aggregated scales, of a silvery white or greenish colour, and of a glimmering pearly lustre; they are friable, very unctuous to the touch, light, and adhere to the fingers. Scaly talc is composed of 50 per cent of silex, of 26 alumine, 1.5 of lime, 17.5 of potash, 5 of oxide of iron, and a small portion of muriatic acid. Its colour distinguishes it sufficiently from chlorite; it differs from the lepidolite principally in respect of colour, and in being extremely unctuous.

It is chiefly met with in small masses in the cavities of primitive rocks, and in the interstices of crystallized quartz. It occurs at Sylva in Piedmont, near Freyberg in Saxony, and near Meronitz in Bohemia.

PEARLSTONE.

Pearlstone occurs in large coarse angular concretions, including smaller round concretions, composed of very thin lamellæ. The surface is smooth and shining, with a lustre remarkably resembling that of pearl. The colour of the mass is grey, greyish black, black, reddish or blackish. It is fragile, translucent on the edges, and scarcely hard enough to scratch glass. Its specific gravity is 2.34; that of Hungary is composed of silex 75.25, alumine 12, lime 4.5, potash 4.50, oxide of iron 1.6, and water 4.5. It almost always gives out an argillaceous smell when breathed on. Some of the varieties are said to bear a striking resemblance to pumice.

At Tokay in Hungary, it is found enclosing round masses of black vitreous obsidian, and is intermixed with the debris of granite, gneiss, and porphyry, and alternating in beds with the latter. A variety met with at Cenapecuaro in Mexico, is hard enough to scratch glass; another found at Cape de Gat in Spain, of a greenish or bluish colour, does not give out the argillaceous odour. Pearlstone is also met with at Sandy Brae, in the island of Egg, one of the Hebrides.

AGALMATOLITE.

This mineral obtained the French and German names of Pierre de Lard and Bildstein, from the resemblance of some of its varieties to Lard; and Brongniart has given it that of steatite pagodite, from its being always brought from China in the form of little grotesque figures and chimney ornaments; but all the analyses of it, distinguish it sufficiently from steatite, which is always in part constituted of magnesia. The agalmatolite is also found at Nagyag in Transylvania. It consists of

56 of silex, 29 of alumine, 2 of lime, 7 of potash, 1 of oxide of iron, and 5 of water. In the varieties of the Chinese, analyzed by Klaproth, no indication of potash was found, and one of them was without lime.

LEPIDOLITE.

The Lepidolite is of a pearl grey, rose red, or of a lilac red, or purple colour, whence it has also been called the *Lilalite.* It consists of an assemblage of small flexible scales, which are translucent: the mass has a pearly or silvery lustre, yields to the nail, and is somewhat unctuous to the touch. Its specific gravity is 2.85: that of Moravia consists of 54 per cent. of silex, 20 of alumine, 4 of fluate of lime, 18 of potash, 4 of oxide of manganese, and 1 of iron.

It was first discovered on the mountain Gradisko, near Rozena, in Moravia, of a pale rose colour and pearly lustre; it occurred also in a thin bed in gneiss, accompanied by quartz, mica, schorl, &c. It has since been met with in Sweden in a quartzose rock; in France, near Limoges, in a vein of quartz, passing through granite, enclosing large beryls; at Campoin, in the island of Elba, of a rose colour, in a rock composed of quartz and felspar.

OBSIDIAN.

Common obsidian is of a greenish or brownish black, or of a smoke brown colour, with a shining vitreous lustre; its fracture is conchoidal; some varieties are translucent, others nearly opake, and it is hard enough to scratch glass: its specific gravity is about 2.35. That of Hecla yields by analysis 78 of silex, 10 of alumine, 2 of lime, 6 of potash, 1 of oxide of iron, and 1 of manganese. Potash and lime do not enter into the composition of all the varieties. It occasionally very much resembles common glass.

The origin of obsidian has been very warmly contested; it is most common in the neighbourhood of Volcanoes, and has been considered as a vitrified lava; whence it has obtained the familiar name of *Volcanic* *glass.* It occurs in beds, masses, and in small isolated pieces.

Fragments of blackish obsidian are met with, not only at the foot of Hecla, but in almost every part of Iceland: It is also found in the Lipari islands; some varieties enclose felspar. In Peru it is met with in parallel beds of a greenish black, and greyish colour; the latter enclosing opake, spherical masses, of a slate colour, composed of diverging fibres. In New Spain, some obsidians, which have been long exposed to the air, are covered by a white opake enamel.

Obsidian, of a greenish black colour, constitutes the greater part of the mountain della Castagna, in the island of Lipari; it encloses small crystals of felspar; and near the peak of Teneriffe obsidian appears in the form of considerable currents, (like lava) presenting some fibrous appearances, denoting its passage into Pumice

A variety of a silky and chatoyant lustre is also found in New Spain.

Obsidian in the form of little grains of the size of peas, of a pearly white, and consisting of very thin concentric layers; together with fragments of these; also vitreous globes of the size of a nut, and others like enamel, traversed by red and black veins; forming altogether a species of vitreous sand, is found at Marikan in the Gulph of Kamschatka; and is thence termed the *Marekanite.*

In the island of Ponce, obsidian is met with, enclosing yellow mica, and white vitreous grains, which appear to be semi-vitrified felspar.

Obsidian is in some places traversed by veins of stony or earthy matter of various kinds; thin beds of which also occur between beds of obsidian. In the Madona mountain, in the island of Ponce, the beds are nearly vertical. In Hungary, obsidian occurs, intermingled with the debris of decomposed granite, gneiss and porphyry; and even alternates with beds of the latter. These circumstannes have induced some mineralogists to doubt the igneous origin of obsidian; but their strongest arguments are——the violent intumescence which it undergoes when subjected to heat, which causes it to melt into a glass, and the quantity of aqueous vapour disengaged during the process. Humboldt suspects this to be one of the causes of the violent earthquakes so often felt in the Cordilleras of the Andes.

But it is agreed universally, that whenever obsidian is found, there exist indications of volcanic agency in the neighbouring country.

In Europe, obsidian has been fashioned into reflectors for telescopes; in Mexico and Peru, it was made into looking glasses and knives.

HAUYNE. LATIALITE.

The Haüyne is usually found massive, but, in one instance, has been observed in extremely brilliant crystals, but so minute, and crossing each other in so many directions, that it was impossible to discover their form. When this mineral is opake, it is of an indigo blue colour; when translucent, bluish green. It is somewhat harder than quartz, is very brittle, and its fracture is uneven, and considerably splendent. Its specific gravity is about 3.2; and it consists of 30 per cent. of silex, 15 of alumine, 20.5 of sulphate of lime, 5 of lime, 11 of potash, 1 of oxide of iron, 17.5 water, sulphuretted hydrogen and loss. In some of its external characters and in its chemical composition, it bears considerable analogy to Lapis Lazuli.

It occurs massive in Italy, in the neighbourhood of Nemi, Albano, and Frascati, accompanied by mica, and green pyroxène; and near Vesuvius, its gangue consists of the fragments of rocks ejected by volcanic eruptions, and it is accompanied by idocrase, augite, mica, and meionite.

Haüy seems to be of opinion that the mineral, heretofore termed *Blue Spinelle*, which occurs in the form of a rhomboidal dodecahedron, in the productions of volcanoes atAndernach, on the banks of the Rhine, ought to be considered as a variety of this mineral; as well as the *sapphirin*, which occurs in the granular form on the banks of the lake of Lach, in a rock principally composed of grains, and of small crystals, of vitreous felspar.

ANALCIME. CUBIC ZEOLITE.

The Analcime is usually met with in round or radiated masses, or in cubic crystals, either perfect, or having each of the solid angles replaced by three planes; or in the trapezoidal dodecahedron, which is a variety of the cube; the lustre is shining, and between pearly and vitreous. The colour of the analcime is white, yellowish, reddish, or deep red; it is hard enough to scratch glass, and is mostly transparent or translucent, occasionally opake; it becomes electric by rubbing. Its specific gravity is below 3. It consists of 58 of silex, 18 of alumine, 2 of lime, 10 of soda, and 8.5 of water.

The analcime is sometimes confounded with stilbite, but amongst their distinctive characters, the superior pearly lustre of the stilbite, is that by which they are mostly readily distinguished.

According to Brongniart, this mineral has been met with only among the products of volcanoes; as in the lavas of Etna: according to Jameson, the cubic zeolite is met with lining the cavities of amygdaloid, basalt, &c.: and occurs in Staffa, and near Talysker, in the island of Sky: it is found also in the Hartz, Bohemia, &c.; in Iceland and the Ferroe islands. At Oberstein, it occurs in the cavities of geodes.

A variety from somma, called the *Sarcolite*, from its being of a flesh red colour, is met with in cubes, having each solid angle replaced by planes.

LAVA.

Lava is externally yellowish or greenish grey, greyish black, or greenish black, and is internally spotted reddish, yellowish brown, or grey; sometimes, when sulphureous vapours have acted much upon it, it is yellowish or sulphur yellow. It is vesicular and knotty; the vesicles are empty; sometimes it is porous. Its fracture is imperfectly conchoidal; internally its lustre is glistening or shining. It is opake, translucent on the edges, brittle, mostly attracts strongly the magnetic needle, and, it is somewhat remarkable, is easily fused into a black glass. The compact lava of Calabria yields, by analysis, about 51 of silex, 19 of alumine, 10 of lime, 4 of soda, 14 of iron, and 1 of water

Lava usually encloses crystals of augite, hornblende, felspar, and leucite; which sometimes have no appearance of being altered by heat.

The above description, generally speaking, belongs to those substances, which, by common consent, are true lavas; the products of Etna, Vesuvius, Hecla, and other Volcanoes. But there are many substances, considered by some mineralogists as lavas, which, by others are not allowed to be of volcanic origin. Karsten enumerates nine species of lava; and Haüy six, which are again subdivided; amongst them are pearlstone and obsidian.

Werner notices only two, one of which he calls *Slag Lava*, the other *Foam Lava*. The slag lava is above described; foam lava is of a greenish grey colour, approaching to greenish black; it is light, brittle, and often crumbling; and has often been confounded with pumice.

PITCHSTONE.

The colours of this mineral, which obtained the name of Pitchstone, from the resemblance which some of its varieties bear to pitch, are very various; it is met with in shades of grey, blue, green, yellow, red, brown, and black; but its colours are not lively: it has a glistening resino-vitreous lustre. It occurs generally in distinct masses or considerable beds, and has an imperfect conchoidal fracture, which in some varieties is the chief characteristic distinction between pitchstone and obsidian; and it is not unfrequently confounded with hornstone and semi-opal. It is almost always opake, or only translucent on the edges, and is hard enough to scratch glass. The specific gravity of that of Meissen in Saxony, is 2.64 or 2.32. Pitchstone is composed of 73 per cent. of silex, 14.5 of alumine, 1 of lime, 1.75 of soda, 1 of oxide of iron, 0.1 of manganese, and 8.5 of water.

The pitchstone of which the analysis is given, is of a yellowish grey colour, and alternates, in the mountain of Gersebach between Meissen and Freyberg, with a porphyry, having a base of petrosilex, which alternates with gneiss, and is traversed by metalliferous veins.—Pitchstone is found in veins traversing granite, near Newry, in the county of Down, in Ireland. In these instances the pitchstone, it seems reasonable to conclude, must be of the same origin as the rocks in which it is imbedded. Mineralogists are not agreed in opinion respecting that of pitchstone in general. Those of Planitz in Saxony, and of Cantal in France, are considered to be of volcanic origin. Pitchstone is met with in Dumfrieshire in Scotland, and in several of the Scottish islands.

CLINKSTONE.

The clinkstone is always found massive, and when struck with a hammer, gives a ringing metallic sound; whence its name. It is of a dark greenish, yellowish, or ash grey colour: its fracture in one direction is slaty, and it is hard, brittle, and commonly translucent on the edges. Its specific gravity is 2.57; and it consists of silex 57.25, alumine 25.50, lime 2.75, soda 8.1, oxide of iron 3.25, oxide of manganese 0.25, and 3 of water.

The clinkstone is usually columnar, and generally rests upon basalt. It occurs near Zittau in Upper Lusace; in the Bohemian Mittelgebirge; in South America; in the island of Lamlash in the firth of Clyde; the isles of Mull and Arran; the Ochil and Pentland hills in Scotland; the Breidden hills in Montgomeryshire, and in the Dirris mountain in the county of Antrim in Ireland.

SODALITE.

This rare mineral has only been found associated with sahlite, augite, hornblede, and garnet, in Greenland. Its colour is light green, or bluish green, and it occurs massive, but more often crystallized in rhomboidal dodecahedrons. It is translucent, and yields with difficulty to the knife. Its specific gravity is about 2.37; and according to the analysis of Thomson, it is composed of 38.42 of silex, 27.48 of alumine, 2.70 of lime, 23.5 of soda, 3 of muriatic acid, 1 of oxide of iron, and 2.1 of volatile matter.

CHABASIE.

This mineral is only met with in crystals very nearly approaching the cube, having the edges and sometimes the angles, replaced by planes; but only three varieties of form have been noticed by Haüy, who considers their primitive to be an obtuse rhomboid of 93° 48′ and 86° 12′.

The colour of the Chabasie is white or greyish, sometimes pale red superficially; it is transparent or translucent, and scarcely hard enough to scratch glass. Its specific gravity is about 2.7; and it consists of 43.83 of silex, 26.6 of alumine, 3.34 of lime, 9.34 of potash and soda, and 21 of water.

The Chabasie is met with in the fissures or cavities of some basaltic rocks, or within geodes of quartz or agate which are disseminated in rocks. It is thus found in the quarries of Alteberg, near Oberstein in Saxony. It is also said to occur in the lavas of the Isle of Ferroe; at Talisker in the Isle of Skye; at Glen Farg in Perthshire, and at Portrush in the North of Ireland.

FETTSTEIN.

The Fettstein has been found only in Norway; it occurs massive, and of a darkish green, bluish grey, or flesh red colour; with natural joints parallel to the faces of a right rhomboidal prism; it is translucent, and scratches glass. Its specific gravity is 2.6; and, according to Vauquelin it is composed of 44 of silex, 34 of alumine, 0.12 of lime, 16.5 of potash and soda, and 4 of oxide of iron.

The Fettstein is by some mineralogists supposed to bear considerable affinity to some varieties of felspar. It has a slight chatoyant lustre when held in particular directions, like that of Labradore felspar. Both soda and potash enter into the composition of Fettstein, the former predominating; the latter only is found in felspar.

SCAPOLITE.

The Scapolite is usually met with in prisms of four or eight sides, either terminated by planes or by tetrahedral pyramids, and aggregated laterally. Their colours are grey or yellowish, sometimes with a pearly lustre; or an almost metallic grey; sometimes deep red and opake; occasionally apple green. The crystals possessing a pearly lustre will scratch glass; but when dull, with an appearance like that of efflorescing, they are tender and even friable. The scapolite is composed of 45 of silex, 33 of alumine, 17.6 of lime, 0.5 of potash, 1.5 of soda, 1 of oxide of iron and manganese; but the efflorescing variety differs, in including some magnesia, and in being without potash.

The Scapolite has hitherto only been met with in the iron mine of Langloe, at Arendahl in Norway; its crystals appear variously grouped, and accompanied by brown mica, quartz, garnet, epidote, carbonate of lime, c.

JADE.

The general character of Jade, of which there are three varieties, are, that it always occurs massive, of various shades of green and whitish green, with a greasy lustre; it is unctuous to the touch, harder than quartz, and very tough.

Common Jade is of a lake green colour, passing into greenish white, semi-transparent, extremely tough, with a glimmering lustre and broad splintery fracture. Its specific gravity is 2.95; and it is composed of 53.75 of silex, 1.5 of alumine, 12.75 of lime, 8.5 of potash, 10.75 of soda, 5 of oxide of iron, 2 of oxide of manganese, and 2.25 of water.

Of the geological history of common Jade, nothing is known. It is found in Switzerland, Piedmont and Tyrol; China and India. It is regarded in the latter countries as a specific for the nephritic cholic, and is fashioned into forms of great delicacy. The Hindoos and Chinese form it into talismans and idols; the Turks into sword and dagger handles.

The *Axestone**, or *Beilstein*, differs from common jade in having a slaty structure, and in being less transparent and less tough. In America, it is found in the banks of the river Amazon; whence it obtained the name of the *Amazonian stone*. It is also met with in Corsica, Switzerland, and Saxony; and in New Zealand and other islands in the Pacific ocean, where it is made into hatchets, tomahawks, and other instruments; whence its common name.

The *Saussurite*, or *Tough Felspar*, is greener than the preceding varieties, and at least as hard and as tough as common Jade: according to Saussure, it consists of 44 parts of silex, 30 of alumine, 4 of lime, 0.25 of potash, 6 of soda, 12.5 of oxide of iron, and 0.5 of oxide of manganese.

It was first found by Saussure, whence its name, in rounded masses on the edge of the lake of Geneva, and afterwards near Turin, in the mountain Mussinet, which is principally composed of serpentine, which enloses hydrophane. It has since been met with in Corsica; in sand, in the neighbourhood of Potsdam, and near Affchanffenberg.

SOAPSTONE.†

The Soapstone is found massive, and nearly white or of a grey colour, sometimes with tinge of yellow, and mottled with green or purple; it is translucent on the edges. Its fracture is somewhat splintery; it yields to the nail; from its general aspect and unctuous feel, its name has been derived.

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* Well wrought *Stone-Axes*, of this material, ſmooth, hard, and deep green, are brought from the Fegee and Friendly Iſlands by our navigators. Thoſe uſed by the natives formerly inhabiting the region around New-York, were formed of a ſort of coarſe chert.

† It is probably this Stone which has been brought from the banks of the Schuylkill, for the purpoſe of conſtructing fire places in Sugar-houſes and Steam-boats. A few years ago, a beautiful variety was brought from Orford in New-Hampſhire. It was manufactured into stoves, hearths, chimney-backs, and cooking apparatus, which for a ſeaſon were conſiderably in uſe. But the ſtone, in addition to its natural brittleneſs, and liability to be warped by heat, was found to be penetrated by veins of quartz, that cracked and ſplit, by expoſure to fire. The ſtone was maſſive, fine, and yielded readily to the plane and chiſſel, except in the parts where the ſilicious material prevailed.

It is met with in a vein in serpentine at the Lizard point of Cornwall, where it may sometimes be found with the appearance of passing into asbestus, which occurs in veins in the serpentine. It is much used in the manufactory of porcelain. It also occurs near the Cheesering, at St. Cleer, in Cornwall.

The soapstone of Cornwall consists of 45 per cent. of silex, 9.25 of alumine, 24.75 of magnesia, 0.75 of potash, and one of oxide of iron. It is commonly supposed to be a variety of steatite, but is much softer. In the composition of the latter, no alumine has been detected.

CHLORITE.

Chlorite is composed of very minute plates intersecting each other in various ways, giving to the mass a granular or earthy structure: it also occurs crystallized in flat six-sided crystals, which are readily divisable into thin laminæ. It is usually of a dark green, sometimes of a yellowish green, with a shining lustre; it is opake, yields to the nail, is somewhat unctuous; and when massive, gives out an earthy smell when breathed on.

Common Chlorite is usually found massive and somewhat solid; its specific gravity is 2.56.

Common chlorite is not found in very considerable masses; but chiefly in the veins and cavities of primitive rocks; sometimes it is enclosed in crystals of quartz, chalcedony, felspar, axinite, &c. in so large a portion as to impart a colour to them. It frequently accompanies the oxide of tin and mispickle in the veins of Cornwall; and occasionally, though rarely, yellow copper. It is met with in most chains of primitive mountains.

When the structure of chlorite is slaty, it is termed *Chlorite slate;* its specific gravity is greater than that of the preceding variety, being 3.03. Its ordinary colour is blackish brown. It is met with in beds in primitive mountains, enclosing crystals of quartz, octohedral magnetic iron ore, garnets &c. and is found in Corsica, at Fahlun in Sweden, in Norway, &c.; and in Perthshire.

Scaly Chlorite is of a dark green colour, and is composed of small glimmering particles, having a pearly lustre; it is somewhat unctuous to the touch; is friable, or loose; and greatly resembles green earth. It is very light, and consists of 26 of silex, 18.5 of alumine, 8 of magnesia, 2 of muriate of soda or of potash, and 43 per cent of oxide of iron.

It mostly occurs in the veins of primitive mountains, principally in clay slate, mixed with quartz, common chlorite, calcareous spar, and micaceous iron ore: it is also met with in granular limestone, and in primitive sandstone. It is found in Saxony, Switzerland, Savoy, Sweden, Hungary, and North Wales.

SCHORL.*

Schorl is found massive, disseminated, and crystallized; the common form of the crystals is a prism mostly striated longitudinally and deeply, and terminated at each end by 3 planes; but the crystals are sometimes very minute, closely aggregated, and divergent. This substance is black, brittle, opake, and has a glistening lustre. Its specific gravity is about 3.2, and it is composed of about 38 parts of silex, 34 of alumine, 1 of magnesia, 6 of potash, 21 of oxide of iron, and a trace of manganese.

Schorl, except by the Wernerian school, is arranged among tourmalines, from which it differs in respect of analysis, transparency and colour. The latter mostly occur imbedded in single crystals; the former is mostly aggregated, and occurs in beds.

It is found in primitive rocks; chiefly in quartz and granite; more rarely in gneiss and micaceous schistus; and is frequently met with in tin veins.

Schorl was first found near the village of Schorlaw in Saxony, whence its name. It is also met with in Bohemia, Bavaria, Switzerland, Spain and Hungary; and at Portsoy in Scotland, and beneath the Logan Rock, and at various places near the Lands' End in Cornwall.

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* For the obſervations on this article, *see Tourmaline.*

CLAY-SLATE.* ARGILLACEOUS SCHISTUS.

The prevailing colour of clay-slate is grey of various shades; it is also bluish or blue; and sometimes greenish, passing into blackish green. Its structure is slaty, and it has a glistening lustre, sometimes approaching to pearly; it is opake, and yields to the knife, but varies in hardness, and some varieties are somewhat unctuous to the touch. Its specific gravity is about 2.7; and it is composed of 48 per cent. of silex, 23.5 of alumine, 1.6 of magnesia, 11.3 of oxide of iron, 0.5 of oxide of manganese, 4.7 of potash, 0.3 of carbon, and 7.6 of water.

Clay-slate occurs in vast strata in primitive mountains, and sometimes in veins. It is very universally distributed in Britain; it is met with in Scotland and the Scottish isles, in the northern parts of England, and plentifully in Cornwall, being the *Killas* of the miner. The principal part of the numerous copper and tin mines of that county are situated in clay-slate; which in most countries abounds in mineral veins.

Some varieties which readily split into thin plates are used for the roofing of houses; another is used for writing on; another as pencils; and some varieties as whetstones.

GABRONITE.

The Gabronite occurs massive, and is of a bluish or greenish grey colour; its fracture is lamellar, it is translucent on the edges, and hard enough to scratch glass, though not to give fire with the steel. Its specific gravity is nearly 3; and it is composed of 54 per cent. of silex, 24 of alumine, 1.5 of magnesia, 17.25 of potash and soda, 1.25 of the oxides of iron and manganese, and 2 of water.

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* *Clay Slate.* Argillaceous ſchiſtus, proper for covering houſes, is brought to New-York, from Rhinebeck, Troy, and other places near the banks of the Hudſon. It is brought to Baltimore from the quarries near the Suſquehannah. As the ſlate region is of vaſt extent in the Fredonian States and territories, the ſupply for internal and domeſtic purpoſes will be adequate to the demands.

A coarſer and more brittle kind from the ſame formations affords good ſtone for walls, furnaces, and other purpoſes.

The Gabronite has only been found in Norway. The bluish variety, near Arendahl, with hornblend; the greenish, at Fredericksvarn, disseminated in a large grained sienite.

FULLER'S EARTH.

Fuller's earth occurs massive, and is usually of a greenish brown colour, sometimes nearly of the colour of slate; it is dull, possesses an earthy fracture, and yields to, and receives a polish from the nail: in water it becomes semi-transparent, and falls into a pulpy impalpable powder. The English Fuller's earth is composed of 53 of silex, 10 of alumine, 0.5 of lime, 1.25 of magnesia, 9.5 of oxide of iron, 1 of muriate of soda, and 24 of water.

At Nutfield, near Riegate, in Surry, it occurs in regular beds near the summit of a hill of considerable elevation, between beds of ferruginous sand or sandstone containing fossil wood, cornu ammonis, impressions of the nautilus and other sea-shells. There are two distinct beds of Fuller's earth; the upper, of a greenish clay colour and 5 feet in thickness, rests upon the other, which is of a light slate blue, and 11 feet thick; in these beds but mostly in the latter, are found considerable masses of sulphate of barytes, sometimes exhibiting regular crystalizations, the interstices of which are occasionally filled up by compact quartz.

Fuller's earth is also found at Deptling, near Maidstone in Kent, and at Aspley, near Woburn in Bedfordshire, under nearly the same circumstances as at Nutfield. At Old Down near Bath, it occurs mixed with shells, forming a bed between the upper and under oolite; and near Nottingham in lumps in the red marl.

It is found near Rosswein in Saxony, under very different circumstances to that of England. It occurs among primitive rocks, and is supposed to originate in the decomposition of green-stone-slate, beneath which it lies.

Fuller's earth was formerly much used in the fulling of cloth (whence its name,) and was forbidden to be exported under severe penalties : soap is now generally substituted.

BASALT.[*]

Basalt is of a greyish black colour, and when polished, of a bluish aspect. It is not easily broken ; its fracture is dull, but fine grained. Some varieties strike fire by the steel, others may be scratched by the knife. It has a tendency to form six-sided irregular prisms or pillars ; of which the Island of Staffa is entirely composed. The Giant's causeway, on the coast of Antrim in Ireland, is a huge pavement of strait pillars of Basalt, running to an unknown distance into the sea ; and the promontory of Fair-head, a little further north, exhibits a continued range, about a mile in length, of columns 250 feet high, and from 10 to 20 in diameter, being the largest yet known. When exposed to weather, basalt crumbles down into a fine black mould, which constitutes a very fertile soil. It is to this rock that some of the richest parts of Scotland owe their fertility.

The basalt of Saxony is composed of 44.5 per cent of silex, 16.75 of alumine, 9.5 of lime, 2.25 of magnesia, 2.6 of soda, 20 of oxide of iron, 0.12 of oxide of manganese, and 2 of water.

Basalt is found under very different circumstances : it occurs filling up veins and fissures in many primitive and secondary mountains ; sometimes forms beds or strata on their summits ; and not unfrequently, it traverses coal-formations, in a direction nearly perpendicular to the beds of coal, which it seems to have the effect of dislocating.

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[*] *Basalt.* *Trap* is the name more generally applied, throughout Europe, for the rock called *Whin* in Scotland, and *Green Stone* in Connecticut, eſpecially in the vicinity of New-Haven.—*(Silliman.)*———It conſtitutes the Palliſado Rock, on the weſt of the Hudſon, between Wehawk and Haverſtraw.

There is a remarkable dyke or wall of the Baſaltic kind in North-Carolina.—(*Lewis.*)———The Trap of Patterſon, at Paſſaick falls, very nearly reſembles the Baſalt of the Giant's cauſe-way.—(*Pierce.*)

Geologists are divided in opinion respecting the origin of Basalt. Werner supposes it to have been deposited, like other minerals, by water which covered the whole earth. Dolomieu conceived basalt to be lava, and all basaltic mountains to be the remains of extinct volcanoes. Dr. Hutton and Professor Playfair conceive it to have been fused by a central fire of the earth, while at the bottom of the sea, and to have been raised up by some natural agent, in common with all other mountains.

With a view to determine the correctness of these opinions, Daubiusson examined the basalt of Saxony, which chiefly lies in the Erzebürge, or metalliferous mountains; a chain separating Bohemia from Saxony, of about 120 miles long, and 3600 feet above the level of the sea. The lower rock is granite, which is covered, or rather wrapt round, by beds of gneiss, mica-slate, and clay-slate, lying above each other in that order. In these beds are situated the great mines of Saxony. In a chain of rocks of serpentine and quartz, are found beds of limestone, of coal, &c. The whole of the eastern part of the chain is covered on one side by a huge bed of porphyry, and on the other by a bed of sandstone of equal magnitude.

Basalt forms the summits of about 20 mountains of this chain, under various forms, as of tables, comes, or domes: the mountains are connected by their sides; the basaltic top alone remaining separate.

In several instances, between the basalt and the body of the mountains, he found beds of sand, gravel, and clay: in others, the basalt rests on sandstone; in others, on porphyry; in one, on mica slate; in three, on granite; and in one, on gneiss.

After a complete investigation of these mountains, Daubuisson is of opinion that there is no analogy between them and volcanic mountains. They are regularly stratified, which is never the case in volcanic mountains; no trace of a crater can be perceived; nor any thing decidedly volcanic. Besides, basalt, wherever found, is always composed of the same consistuents; lava varies considerably. The substances contained in basalt, as felspar, mica, &c. retain their crystalline characters without exhibiting the slightest traces of the action of fire, though the felspar is more fusible than the basalt istelf. Basalt contains 20 per cent. of iron, and there is no rock which could furnish such a proportion. It contains 5 per cent. of water of composition, which is never found in lava. It is found lying immediately under or over coal, which is in no degree altered in its nature; and Dolomieu has described no less than 20 beds of basalt alternating with as many beds of limestone containing marine shells. For these and many other conclusive reasons, Daubuisson is decidedly of opinion that the Saxon basalt is altogether of aqueous origin.

He was afterwards induced by some zealous advocates for the igneous origin of basalt, to explore the baslt country of Auvergne in France. The base of this country he found to be granite; which, in the western part, is covered with gneiss and micaceous schistus, containing metalliferous veins. Limestone and coal also appear in other districts. The chain of the Puys extends above 20 miles: most of them are detached; their form is a truncated cone; and on their summits there are cup-like depressions, in some instances 200 feet deep. Their general elevation is from 900 to 1300 feet above the plain; the central and highest, the Puy de Dome being near 2000 feet.

The substances chiefly composing these hills, are, scoriæ, lava, and other decided volcanic matter.

In one instance he traced the appearance of a stream like that of lava, 200 feet broad; which afterwards divided; the soil it affords is unfruitful.

Its characters differ in some respects from common basalt; the felspar has a vitreous aspect, and the quartz is altered by heat.

Many other circumstances also contributed to induce the full belief that the basalt of Auvergne is of igneous origin.

There seems therefore sufficient grounds for concluding that, as the basalt of Saxony is altogether of aqueous origin, and that of Auvergne of igneous origin, these two rocks ought not, however, in point of composition and aspect, they may resemble each other, to receive the common name of basalt. This seems to be one of the numerous causes of confusion in geological nomenclature.

In Scotland, basalt is included, together with many other rocks of very different natures, in the vague, but comprehensive term *Whin-stone.*

The Eight following substances have not been analyzed, but are in most mineralogical arrangements associated with those of which the principal ingredient is Silex.

HORNSTONE.

This substance occurs in nodules and massive, with a splintery fracture, and is translucent, passing into opake; it is scarcely so hard as quartz, and is infusible. Its general colour is grey, which is tinged blue, green, brown, red or yellow.

Hornstone is described as occurring in round masses in limestone, as in Bavaria; and in beds in limestone on the banks of the Menai in Caenarvonshire; and sometimes as forming the basis of porphyry, as in Sweden, at Dannemera and Garbenburg, and also in the Shetland isles. Wood, petrified by hornstone, thence termed *Woodstone* is met with in ferruginous sand near woburn in Bedfordshire, and near Nutfield in Surry. I have met with Hornstone in Pednandrae Mine in Cornwall, passing into *Chert,* which is considered to be allied to it; the fracture of Chert is flat conchoidal, and it generally has a waxy or greasy lustre, and is translucent on the edges. Its general colour is grey.

There is a considerable bed of Chert near the summit of the Cliff at the Western lines in the Isle of Wight; resting, I believe, on sandstone, which having given way by exposure, the fall of the Chert has been the principal occasion of the now beautiful ruin beneath. Chert also occurs in some parts of Devonshire and Dorsetshire, and is employed for repairing the roads. It also occurs resting upon the ferruginous sand or sandstone of Leith Hill in Surry; near the summit of which, the sand, like that beneath the Chert in the Isle of Wight, contains organic remains which are denominated Alcyonia.

CHIASTOLITE.

This mineral has only been met with crystallized in long slender rhomboidal prisms, composed of two distinct substances. The exterior is greyish white or reddish, the interior is black or bluish black, and its sides are perfectly parallel with those of the exterior substance, which, in some specimens, is so thin as to form a mere coating. From each of the angles of the interior prisms, there often proceeds a black line which sometimes reaches the corresponding angles of the coating, but is sometimes terminated by a black rhomboidal prism; so that the Chiastolite occasionally consists of 5 black rhomboidal prisms, communicating by black threads, and as it were imbedded in a greyish white or reddish substance, which has a lamellar structure, is translucent, and hard enough to scratch glass.

This substance seems only to have been discovered imbedded in argillaceous or micaceous schistus. In the former, it occurs in the Wolf-crag near Keswick, and on the summit of Skiddaw, in Cumberland; and also at St. Jaques de Compostella in Spain. In the latter, it is met with in the Sierra del Marao in Portugal. The Chiastolite is also found in Britany in France, in the valley of Barège in the Pyrennees, and at Aghavanagh, and Baltinglass-hill, in the county of Wicklow in Ireland.

SPINELLANE.

The Spinellane has only been found on the borders of the lake of Laach, in a rock composed of grains and small crystals of glassy felspar, quartz, hornblende, black mica, and magnetic iron ore. It occurs in small rhomboidal dodecahedrons of a dark brown colour, and is so hard as to scratch glass.

MELILITE.

This rare mineral has been met with chiefly in small rectangular parallelopipeds; occasionally in rectangular octohedrons. Internally the crystals are of a honey yellow or orange colour; externally they are usually coated by oxide of iron of a yellowish brown colour; they give sparks by the steel. The Melilite has only been found at Capo di Bove near Rome, in the fissures of a compact black lava.

WACKE.*

Wacke is of various shades of greenish and yellowish grey, and occurs either solid or cellular: when the cells are hollow, or filled by some other substance, as quartz, chalcedony, or carbonate of lime, the compound is denominated *Amygdaloid*. Wacke has an earthy fracture, is opake, and generally yields easily to the knife.

According to Werner it occurs in beds, which generally lie under basalt, and above clay, as at Fichtelberg, and Marienberg, in the hills of Schnegenberg; and frequently contains imbedded crystals of mica, and basaltic hornblende. It also occurs in veins. At Joachimsthal in Bohemia it encloses petrified wood, native bismuth, and fragments of certain primitive rocks; and at Kallennordheim in Franconia, fossil bones: it is found also at Westmanland in Sweden, and in Iceland.

The *Amygdaloid* or *Toadstone* of Derbyshire is considered by Werner to be a variety of transition Trap.

Iron Clay, the *Eisenthon* of Werner, is considered by some as a variety of Wacke; their general characters are the same; but the colour of the former is reddish brown; they both occasionally constitute the basis of amygdaloid.

SHALE.† SLATE-CLAY.

Shale occurs only massive; its general colour is grey, which sometimes is bluish, yellowish or blackish; in

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* *Wacke.* This has been found in detached maſſes. Fine Amygdaloid, of a brown colour, and interſperſed with white ſpots, has been brought from Labrador.

† *Shale.* Carbonaceous ſhale, or coal ſlate, overlays the ſtrata of Coal in Rhode-Iſland, and is diſtinguished by impreſſions of fern and capillary plants.—(*Case.*)

At Glaſtonbury, near Connecticut river, bituminous Shale exiſts, conone direction its structure is slaty, in the other, earthy; it usually adheres a little to the tongue and yields to the nail, and is opake, meagre to the touch, and dull, except from casually imbedded mica, which sometimes imparts a glimmering lustre: its specific gravity is about 2.6.

Shale has the usual characters of clays, by becoming plastic in water; it disintegrates on exposure to air. A variety found at Menil-montant near Paris, enclosing the menilite, yielded 66 per cent. of silex: it adheres strongly to the tongue.

It is found in beds and strata in schist; in alluvial deposites; and resting upon, as well as interposed between, beds of coal, which it invariably accompanies. It often contains impressions of reeds and of ferns; and I am informed by my friend L. W. Dillwyn, well known for his curious botanical researches, that he has never discovered a single impression of fern in shale, perfect as these impressions usually are, exhibiting its well known appearance of fructification.

A variety of shale usually accompanies coal, and is sometimes intermixed with it, which, from its black colour and bituminous quality, is termed *black bituminous shale.* It occurs in every independent coal-formation. Its structure is slaty: when subjected to the flame of a candle, it blazes; in the fire it crackles, emits a black smoke and bituminous odour, loses a considerable portion of its weight, and is converted into a whitish or reddish flaky ash.

Another variety of Bituminous shale, of a *brown* colour, is met with at Kimmeridge in Hampshire, which from its giving out a bituminous odour when placed in the flame of a candle, or in the fire, is termed *Kimmeridge Coal.* By exposure to a considerable heat, the

taining plain impreſſions of fiſh, with their ſcales, fins, rays, and other parts, very apparent.—(*Bruce.*)

Argillaceous Shale has been brought to me from Wilkesbarre, in which were impreſſions of ferns, and of the bark, to all appearance, of the Palm-tree.—(*Bradbury.*)

The Killas of the Waalkill, near Montgomery, abounds with ſhells of bivalve molluſcas, ſuch as anomias and terebratulas. In theſe, the real ſhells exiſt; being neither waſted away ſo as to leave cavities and impreſsions, nor converted by petrifaction to a ſtony condition.

bituminous part is consumed, and it is reduced to a grey earthy ash.

FLINTY SLATE.* INDURATED SLATE. SILICEOUS SCHISTUS.

Of Indurated Slate, there are two or three varieties.

Common indurated Slate. This substance is of about the same hardness as quartz, which commonly traverses it in small white veins. Its colour is very various; grey bluish grey, and red; its structure is somewhat slaty, and it is translucent on the edges.

A specimen analized by Weiglib yielded 75 per cent. of silex, the remainder being lime, magnesia, and oxide of iron.

It is chiefly found in beds in transition mountains, and occurs in Saxony, the Hartz, in the Lead hills and other places in the South of Scotland. At Saaska in the Bannat, and in Greece, it occurs in large masses in transition limestone.

Lydian Stone, or *Basanite*, is of a black or greyish black colour, and is always found massive, never with a slaty structure; it is often traversed by veins of quartz; it is opake, less hard than the foregoing variety, and its fracture is flat conchoidal.

It occurs in similar formations and repositories with common indurated slate; and is found near Prague and Carlsbad in Bohemia; near Freyberg in Saxony; and in the Moorfoot and Pentland Hills near Edinburgh. It was first brought from Lydia in Lesser Asia; whence its name.

When polished, it is used to try gold and silver upon, by a comparison of colour, and has thence obtained the familiar name of the *Touchstone.*

Striped Jasper by some is considered as a variety of agate or jasper, by others, of flinty slate; it sometimes shews a tendency to a slaty structure; it occurs in bands or stripes of various shades of yellow, green, purple, and red; from which it has obtained the familiar name of *Ribbon Agate*, or *Ribbon Jasper*.

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* *Flinty Slate.* The Touch-ſtone is occaſionally found along the ſhores near New-York, in rounded maſſes; which, by the blackneſs of their ſmoothed ſurfaces, contraſt well with the gold, ſilver and copper, which are rubbed upon them.

It is found in considerable beds. It occurs in Saxony, the Hartz, and in Sicily; and forms whole hills in Siberia.

WHETSLATE.*

It is found massive, with a slaty structure, and is most commonly of a greenish grey colour, sometimes yellowish or brownish grey; it is translucent on the edges, yields to the knife, and is somewhat unctuous to the touch.

It occurs in primitive mountains at Lauenstein in Bayreuth, in Saxony, and near Freyberg in Bohemia; it was first brought to Europe from the Levant. When cut and polished, it is used for sharpening knives and other instruments; whence its name.

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[*] *Whetslate.* A ſpecies of ſlaty whetſtone is quarried in the north-eastern part of Pennſylvania, and has been brought to New-York, for the purpoſe of ſharpening edged tools. It is of an olive-brown colour, of a fine ſmooth grain, and eaſy to work; but its ſoftness makes it wear away too fast.

ALUMINE or ARGIL.

This substance obtained the name of Alumine from its forming the base of common Alum; and that of Argil, from the Latin, Argilla, Clay, on account of its being a constituent of Clays, though rarely in a greater proportion than one-third or one-fourth; nevertheless, clays are termed *argillaceous substances*, and those rocks, of which Argil forms a notable proportion, are termed *Argillaceous rocks;* one character of which is, that they give out a peculiar odour when breathed on, that may always be regarded as a mineralogical test of the presence of Argil, whence it has been termed the *Argillaceous odour;* but as it does not belong to pure Alumine, it is considered to be owing to a combination of that substance with the oxide of iron, which generally enters into the composition of argillaceous minerals.

Alumine, when pure, is perfectly white, and is destitute of taste and smell; its specific gravity is 2.0: and it is infusible, except by voltaic electricity. It has already been said, in treating of the Earths generally, that Alumine is not a simple substance, and that Sir H. Davy has ascertained it to be composed of oxygen united with a base, *Alumium*, in the proportion of 46 of the former to 54 of the latter; but though the results afford a strong presumption that Alumine is a metallic oxide, its base has not been yet obtained in such a state as to make it a fit object for investigation.

As the precise nature of its base is unknown, Alumine is still ranked among the Earths. As an earth, it may be said that it is never found pure. It enters largely into the composition of many earthy minerals, and in small quantity in some metalliferous ores. It is an ingredient, in a large portion, of some of the most abundant rocks, primitive, secondary and alluvial, and is found in all soils. It is the most abundant of all the Earths, except Silex.

It occurs combined with the fluoric and sulphuric acids; and with the Alkalies, Potash and Soda.

Alumine is found in the greatest purity in corundum and its varieties.

CORUNDUM.

The varieties included under this term, viz. Corundum, Oriental Ruby, Saphire, and Emery, are the hardest substance in nature, except the Diamond, and the most ponderous of stony substances; their specific gravity varies from 3.66 to 4.08. The saphire is the heaviest. The lamellar structure is remarkably visible in the common Corundum, which readily splits into rhomboids, of which the angles are considered to be 86° 38′ and 93° 22′. All the varieties of Corundum belong exclusively to primitive countries.

Common Corundum, probably from its texture, has received the name of *imperfect* Corundum; and from its hardness, that of *Adamantine Spar*. It is sometimes nearly colourless, and somewhat translucent; but more often has a greyish or greenish tint, occasionally reddish, or brownish, with a metallic chatoyant lustre; it is more rarely yellow and transparent, or black and opake. The common form of its crystal is the hexahedral prism, which rarely shews a tendency to flat triedral terminations; it occurs also in obtuse, and in acute, hexahedral pyramids. It consists of about 90 per cent. of alumine, 5 of silex, and some oxide of iron: in some varieties of Corundum, the latter does not exceed one per cent.

Adamantine spar is found in India, in a granite rock, imbedded, after the manner of felspar. It is often accompanied by the fibrolite, talc, garnet, zircon, and magnetic iron. It is also found in China, nearly under the same circumstances. It occurs every where from China to Bengal; in the kingdom of Ava, and on the coast of Malabar: its gangue, in the Carnatic, is a coarse-grained white marble. It has been found in Italy in micaceous schistus, and entering into the composition of granite in North America.*

The yellow is found in Bengal; the brown, with a chatoyant lustre, on the coast of Malabar; the black in China.

In the East Indies it is used for polishing steel, and cutting and polishing gems; but the lapidaries of Europe prefer diamond-powder, on account of the greater rapidity with which it works.

The *Oriental Ruby*, or *Oriental Amethyst*, is usually of a brilliant red colour; sometimes nearly of a violet colour; occasionally either wholly, or partly, colourless and transparent; often chatoyant, when it is termed *Asteria*, or *Star-stone*.

The *Saphire* varies from the preceding variety principally in respect of its colours, which are blue, yellow, or yellowish green; when blue, it is properly the saphire; when yellow, it is by lapidaries termed the *Oriental Chrysolite*, or *Oriental Topaz*; when yellowish green, the *Oriental Emerald*.

The Oriental ruby and the saphire do not essentially differ from common corundum in respect of analysis. A variety of the latter consisted so nearly of pure alumine, that Klaproth found only 0.5 of silex and 1 of oxide of iron. The general forms of their crystals are much the same as those of common corundum, but their planes are usually more numerous. These gems are said to have been found in granite, and in sienite, in the kingdom of Pegu and the Island of Ceylon: but they are more commonly met with in alluvial deposites, and in brooks in the neighbourhood of primitive mountains. They have been thus found in the brook Expailly in France; near Meronitz and Billin in Bohemia; they have also been found in the province of Forez in France.

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* Good judges affirm that Adamantine Spar has been found near Philadelphia, in the neighbourhood of Baltimore, and at Haddam, Conn. in granite. That of Cheſnut-hill is, in external appearance, very much like that of Bombay, but differs from it in being free from pyrites, and in being much more regularly figured. Its colour is a light green, and its hardneſs ſuch as to cut glaſs very readily. Some ſpecimens have the luſtre of glaſs, while others are not ſo bright. It is bedded in granite, or rather forms an ingredient of that rock, aſſociated with fleſh-coloured feldſpar, ſmoky quartz; greeniſh mica, ſtriated cryſtals of black ſchoerl, and ſometimes ſmall garnets.—(*Med. Repos. Vol. 3, p. 202.*)

The value of these gems in jewellery is well known. It is said that those of a light blue colour, may be divested of it by heating them in a charcoal crucible, without injuring their other properties, and that they are then often sold as diamonds.

Emery, though it bears very little resemblance to the preceding, is, from its hardness and analysis, considered to be a variety of Corundum. It usually occurs in masses of a blackish or bluish grey colour, having the aspect rather of a fine grained rock, than of a simple mineral.

It is found in the East Indies, enclosing whitish or reddish talc, and small portions of magnetic iron. That of Jersey resembles magnetic iron in mass, enclosing white Mica. That of Smyrna is also micaceous; and encloses magnetic iron and sulphuret of iron. In the isle of Naxos, emery is found in rounded masses at the foot of primitive mountains. It occurs in Italy and in Spain: but that of Ochsenkopf, near Swartzenberg in Saxony, seems to be the only variety which has been seen in its native place. It is disseminated in a bed of hard steatite, of a yellowish grey or apple green colour, mixed with common talc.

It is largely used for cutting and polishing by lapidaries, and by workers in glass, steel, &c.

FIBROLITE.

The Fibrolite is white, or of a dirty grey colour: it is fibrous, and harder than quartz. The fibres are rarely so large as to present any very determinate form; but the Count de Bournon observed some in that of a right prism with rhombic bases, of which the angles are 100° and 80°. The Fibrolite is infusible; its specific gravity is about 3.2; and it is composed of 58 of alumine and 38 of silex.

It is found accompanying crystals of corundum in the Carnatic and in China.

ROTTENSTONE.

The Rottenstone is commonly considered as a variety of Tripoli, from which it essentially differs in respect of composition. It is found at Bakewell in Derbyshire. It is of a dirty reddish brown or nearly black colour, yields to the nail, and is fetid when rubbed or scraped: it is composed of 86 parts of alumine, 4 of silex, and 10 of carbon.

PINITE.*

The Pinite is found generally in six-sided crystals, sometimes modified, of a brown, blackish-brown or grey colour: externally its crystals are ochreous, and usually give out an argillaceous smell when breathed on. The Pinite consits of about 74 of alumine, 29 of silex, and 7 of oxide of iron.

It was first discovered in granite, near Schneeberg in Saxony, in the mine called Pini, whence its name: it has since been found in the Puy de Deme in France, in a porphyritic felspar: it also occurs at St. Michael's Mount, in Cornwall, in granite veins; at Ben Gloe and Blair-Gowrie in porphyry.

CYANITE,† OR SAPPARE.

This mineral usually occurs in lamellar oblique prisms, of a bluish or pearl-grey colour, having a pearly lustre: it scratches glass when held in one direction, but yields to glass in another direction: it becomes electric by friction. Its specific gravity is about 3.5, and it consists of about 55.5 per cent. of alumine, 43 of silex, and 0.5 of oxide of iron. It is infusible.

It is usually found in primitive rocks; and occurs in Scotland, at Bohan in Banffshire; near Banchory in

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* *Pinite*—At Haddam, in cryſtals which are ſometimes ſeveral inches in length, ſituated in micaceous rocks.—(*Silliman.*)

† *Cyanite.* Found in large lamellar maſſes, at Cheſterfield, Maſs. (*Hunt.*) and various other places, in Maryland, Pennſylvania, Connecticut, and Maine.

Aberdeenshire: and in the Mainland, the largest of the Shetland islands: it also occurs in the Tyrol; in Siberia; and near Lyons, in France, in granite, &c.

DIASPORE.

The Diaspore is a rare mineral, having for its gangue a ferruginous clay, but nothing is known of its geological situation. It is composed of a mass of slightly curvilinear laminæ of a pearly lustre, which may be readily separated from each other. By exposure to the heat of a candle, it crackles and flies off in minute fragments with a brisk decrepitation: this is supposed to be owing to the water it contains. The Diaspore scratches glass; it specific gravity is 3.43; and it consists of 80 per cent. of alumine, 0.3 of iron, and 17 of water. It is conjectured by some to be a variety of the Wavelite.

STAUROLITE.*

The Staurolite is of a greyish or reddish brown colour, and occurs usually in rhomboidal or hexahedral prisms, of which the terminal edges are sometimes replaced. Haüy has noticed seven varieties in the form of its crystals, which commonly intersect each other at right angles; and he considers the primitive to be a right rhomboidal prism of 129° 30′ and 50° 30′. The Staurolite is sometimes opake, sometimes translucent, with a vitreous lustre; of about the hardness of quartz, and infusible. Its specific gravity is about 3.30; and it is composed of 52.25 of alumine, 27 of silex, 18.5 of oxide of iron, and 0.25 of oxide of manganese.

When of a reddish brown colour, and in the form of four or six-sided prisms, it has sometimes, from its resembling the garnet in colour, been called the *Grenatite*.

The Staurolite belongs to primitive countries. It has been found in Brittany, near Quimper, in a micaceous clay, considered to be the debris of a primitive rock : it occurs also at St. Gothard, imbedded in micaceous schistus ; and at St. Jago de Compostella in a primitive rock, and is accompanied by the Cyanite.

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* *Staurolite.* The firſt American Staurolites I ſaw, were from Virginia, having been found looſe on the ground of the upper country, where they might be gathered by handfulls. The cryſtals croſſed each other obliquely.—(*Burwell.*) This mineral was brought from Maine.—(*Godon.*) Fine ſpecimens have been received from Bowdoinham or its vicinity.—(*Cleaveland.*)

AUTOMALITE.

The Automalite is by some considered to be a variety of the Spinelle Ruby ; and as it contains a considerable proportion of the oxide of zinc, it has obtained the name of the *Zinciferous Spinelle ;* sometimes it is called the *Gahnite*, in honour of Gahn, its discoverer. The specific gravity of the Automalite is 4.26—4.69 : it is therefore much heavier than the Spinelle Ruby, from which it also differs in being nearly opake, and of a dark bluish-green colour, as well as essentially in respect of composition : it consists according to Vauquelin of 42 parts of alumine, 4 of silex, 28 of oxide of zinc, 5 of oxide of iron, and 17 of sulphur. Some mineralogists have concluded that the Automalite is the Pleonaste loaded with sulphuret of zinc ; which amounts to an acknowledgment that it is essentially a very different substance ; and therefore it ought not to be considered, any more than the Pleonaste, as a variety of the Spinelle Ruby.

It is found only at Fahlun in Sweden in a talcosed rock.

CHRYSOBERYLL.

This substance occurs in rounded pieces, massive, and crystallized ; it is of a green colour, sometimes with a yellowish or brownish tinge, and occasionally shows an opalescing bluish white light internally. The general form of the crystals is prismatic ; the prisms are terminated by a variable number of planes. It readily becomes electric by friction ; is infusible, semi-transparent, and scratches quartz. Its specific gravity is about 3.8. That of Brazil is composed of 71.5 per cent. of alumine, 18 of silex, 6 of lime, and 1.5 of oxide of iron. It is sometimes called the *Oriental* or *Opalescent Chrysolite.*

It is chiefly procured from Brazil, where it is found accompanying topazes; and has been noticed in sand from Ceylon, together with rubies and saphires: a few specimens have been brought from Nerbschinsk in Siberia. Its geological situation is not known.

SOMMITE.

The Sommite usually occurs in grains, or in small regular hexahedral prisms (the form of the primitive crystal,) of which the lateral edges are sometimes replaced. It is of a greyish or greenish-white colour, with a shining vitreous lustre, and scratches glass. The Sommite considerably resembles phosphate of lime, but may be distinguished by its superior hardness, and by its not giving a phosphorescent light when placed on a live coal. Its specific gravity is about 3.2; and it is composed of 49 of alumine, 46 of silex, 2 of lime, and 1 of oxide of iron.

It has been found only in the cavities of the lava of that part of Vesuvius called Mont Somma; where it is accompanied by mica and idocrase.

MEIONITE.

This mineral, like the preceding, has only been met with among the substances ejected by Vesuvius, in the cavities of white granular limestone. It usually occurs in four or eight-sided prisms, terminated by tetrahedral pyramids. Haüy notices three varieties in the form of its crystals, of which he considers the primitive to be a right prism with square bases: its colour is whitish, or greyish white, with a shining vitreous lustre, and it is translucent or transparent. Its specific gravity is 3.1.

PLEONASTE.

The Pleonaste is commonly considered to be a variety of the Spinelle Ruby; but it is less hard, and a little heavier, and differs from it greatly in colour and in composition. Its specific gravity is about 3.8; and it is composed of 72.25 of alumine, 5.48 of silex, 14.63 of magnesia, and 4.26 of prot-oxide of iron. Its general colours also differ from the Ruby: the Pleonaste appears nearly black; but when placed between the eye and the light, it is translucent, and green or blue. Some have been brought from Ceylon of a sky-blue, others of a yellowish colour.

The Pleonaste principally agrees with the Spinelle Ruby, in being chiefly composed of alumine, and in external form; both occur in the octohedron, which passes into the rhomboidal dodecahedron.

The geological situation of the Pleonaste differs for the most part from that of the Spinelle Ruby. The Pleonaste is found, accompanied by tourmalines, &c. in the rivers and alluvial country of Ceylon. It has often been found in the cavities of the lavas of Vesuvius, and of Somma. It is also met with in the volcanic rocks of Somma, both calcareous and granitic; and in those of Laach, near Andernach, on the banks of the Rhine.—Haüy seems to be of opinion that the latter, which is commonly termed the *blue Spinelle*, should be considered as a variety of the Haüyne.

LAZULITE.

This mineral is by Jameson called the *Azurite*, and is perfectly distinct from Lapis Lazuli, which is not satisfactorily ascertained ever to have been found in a crystalline form; whereas the Lazulite is often found in quadrangular, though not very perfect, crystals of a blue colour; it is rarely massive, and then in fine grains, or in masses not exceeding the size of a hazel nut: it is translucent on the edges, brittle, and nearly as hard as quartz. It is composed of 66 per cent. of alumine, 10 of silex, 2 of lime, 18 of magnesia, and 2.5 of oxide of iron.

It occurs in Vorau in Stiria, in a gangue of quartz, in a vein passing through micaceous schistus; but the most beautiful specimens are found in the bishoprick of Salzburg.

ANDALUSITE.

The Andalusite occurs in small masses of a reddish or purplish colour, having a lamellar structure, with natural joints parallel with the sides of a rectangular prism; it scratches quartz, and sometimes even the Spinelle Ruby. Its specific gravity is 3.16; and it is composed of 52 of alumine, 38 of silex, 8 of potash, and 2 of oxide of iron.

This mineral is, on the one hand, considered by some to be a variety of felspar, which is very fusible; but the Andalusite is infusible: on the other hand, it is considered by others, probably from its hardness, as allied to Corundum.

The Andalusite belongs to primitive countries. It occurs in a vein of felspar traversing granite in Forez in France: also in granite in Castelle in Spain; in Aberdeenshire in Scotland; and in Dartmoor in Devonshire: it has also been found in Douee Mountain, in the county of Wicklow, and at Killiney in the county of Dublin, in Ireland.

BLUE FELSPAR.

This mineral is by some considered to be a variety of Felspar, from which it differs in respect of colour and of composition; also, it is less fusible and somewhat harder. In most of these respects it likewise differs from the Andalusite, of which it has also been considered as a variety. It occurs massive; its colour is pale blue or sky-blue; it has a lamellar structure, being divisable, though with difficulty, into rectangular prisms; and it is not quite so hard as quartz. Its specific gravity is 3.06; and it is composed of 71 of alumine, 14 of silex, 3 of magnesia, 3 of lime, 0.25 of potash, 0.75 of oxide of iron, and 5 of water.

Hitherto it has only been found at Krieglach in Styria, forming part of a rock, consisting likewise of quartz, and mica, or talc.

WAVELLITE.

This mineral is most commonly to be observed in small fibres, occasionally in six-sided prisms, diverging from a common center; it is said also to have occurred in small octohedrons either perfect, or having the apices replaced. The Wavellite, when fibrous, has a silky lustre; when crystallized, a vitreous lustre; it is translucent: its colour is various; white, or greyish, greenish or bluish-white: it is harder than calcareous spar; its specific gravity is about 2.4; that from Barnstaple is composed of 71.5 of alumine, 0.5 of oxide of iron, and 28 of acidulous water, which, as it corrodes glass, by the application of heat is supposed to contain a slight portion of fluoric acid: from its being chiefly composed of water and argil, it is sometimes termed the *Hydrargillite*.—The Wavellite of Brazil contains about 4 per cent. of silex.

It was first discovered by Dr. Wavel in small veins and in cavities of a tender argillaceous schistus, near Barnstaple in Devonshire; it has been since found at Stenna Gwyn, in Cornwall: on a specimen in my possession from the latter place, of which the gangue is quartz, Wavellite is accompanied by small crystals of Uranium of a bright yellow colour: it has also been found near Cork in Ireland; and has been brought from Brazil by M. Mawe, in the form of stalactites.

TOPAZ.

The Topaz is found only crystallized: its general form is prismatic, and it is variously and dissimilarly terminated: the prism is usually striated longitudinally, and modified. It is sometimes limpid, and nearly transparent, or of shades of yellow, green, lilac, and red, and translucent. It mostly becomes electric by heat, with polarity; it exhibits a double refraction: its specific gravity is 3.5; the white Brazilian topaz consists of 50 per cent. of alumine, 29 of silex, and 19 of fluoric acid: those of a yellow colour occasionally yield a small portion of oxide of iron. The topaz of Saxony consists of more silex and alumine, and less fluoric acid.

The pale greenish and almost transparent topaz of Siberia becomes electric by being heated, not by being rubbed: the Saxon Topazes, of a pale yellow colour, become electric by friction, not by heat; but lose their colour by being subjected to fire; the deep yellow Topazes of Brazil, become electric by heat, and red by being placed in the fire. Haüy now considers the primitive crystal of the Topaz to be a rectangular octohedron of 82.° 2′ and 122.° 42′; but these admeasurements are not corroborated by the reflecting goniometer. The crystals in my possession exhibit 37 varieties of form: many of them are from Cornwall

The Topaz is found almost exclusively in primitive countries of the oldest formation; chiefly in tin veins traversing granite; in which it is sometimes found imbedded.

It occurs in the tin veins of Schlackenwald in Bohemia, and occasionally in those of Cornwall, accompanying tin, fluate of lime, and mispickel. The Topazes of Cornwall are mostly small, colourless, sometimes tranparent, sometimes opake and nearly milk white: they occur in the mines in St. Agnes, and in veins in the granite of St. Michael's mount, and are frequently accompanied by phosphate of lime and quartz. In the valley of Danneberg in Saxony, the Topaz is imbedded in a rock together with quartz, black schorl, mica, and lithomarga, forming an aggregate which has obtained the name of the *Topaz Rock*. In the Uralian mountains, Topazes are found in graphic granite: in Brazil, they occur imbedded in an argillaceous earth, resulting, as it is believed, from the decomposition of primitive rocks.

Pyrophysalite is considered to be a variety of the Topaz; it is of a greenish white colour, and not quite so hard as quartz; by heat it gives out a greenish phosphoric light. It is found at Fahlun in Sweden in round masses, in a granite composed of white quartz, of felspar, and silvery white mica; from which these masses are separated by talc of a greenish yellow colour: it is composed of about 54 alumine, 34 silex, and 10 fluoric acid.

PYCNITE, OR SCHORLACEOUS BERYL.

The Pycnite is only found in six-sided prisms which are deeply striated longitudinally, and are composed of minute parallel prisms, to which the longitudinal striæ may be owing. It is usually of a dull yellowish or reddish white colour, and translucent; it may be readily broken across the prism: it scratches quartz: its specific gravity is 3.5; and it is composed, according to Vauquelin, of 60 per cent. of alumine, 30 of silex, 2 of lime, 6 of fluoric acid, and 1 water.

It is found entering into the composition of a rock, chiefly consisting of quartz and mica, at Altenberg in Saxony: it is said also to have been met with in Bavaria.

SPINELLE RUBY.

The Spinelle Ruby is usually found crystallized, either in the form of its primitive, the regular octohedron, or its variety, an acute rhomboid, or having the edges of the octohedron replaced; and occasionally in macles presenting alternate re-entering angles. It is of various shades of red, violet, or yellow; more rarely black. It scratches quartz easily, but is not so hard as oriental ruby, from which it is readily distinguished both by its colour and crystallization. It is infusible: its specific gravity is 3.7; and it consists of 84.47 alumine, 8.78 magnesia, 6.18 of chromic acid; to the latter its colour is supposed to be owing.

Like the greater number of the gems, the geological situation of the Spinelle Ruby is not accurately known.

It sometimes occurs with saphires and oriental rubies in the sand of rivers: it is found in the sand of the rivers of Ceylon. It has been met with in India in a lamellar carbonate of lime, enclosing red mica, sulphuret of iron, and phosphated lime; also in a substance greatly resembling adularia.

The scarlet coloured is properly termed the *Spinelle Ruby;* the rose red, the *Balas Ruby:* the yellow, or orange red, the *Rubicelle;* the violet coloured, the *Almandine Ruby.*

The pleonaste and automalite are usually considered to be varieties of the Spinelle Ruby, but they differ essentially in respect of composition.

SUBSULPHATE OF ALUMINE.

This mineral has been found in two places: it is said to have occurred in others.

It was first discovered in the neighbourhood of Halle in Saxony, in small masses, immediately under the soil, accompanied by foliated gypsum and selenite. These masses are snow white, or yellowish white and opake, adhere slightly to the tongue and yield to the nail; they are very meagre to the touch, light and infusible. By the aid of a glass, they appear to consist of a multitude of transparent, prismatic crystals.

This mineral has by some mineralogists been considered as an artificial production: a suspicion arising from the proximity of the place at which it is discovered to the college of Halle. Jameson is of opinion that its form is a sufficient proof of its being a natural production and adds that there is no laboratory nearer to the spot where it is found, than a quarter of a league.

The Subsulphate of Alumine has been since discovered by M. Webster in small masses, of a snow white colour and opake, lying upon the chalk, and filling up a hollow in it, at Newhaven in Sussex; it has very much the same characters as that found at Halle; but is considered to be purer.

ALUM.*

ALUM (of La Tolfa) consists of 49 per cent. of sulphate of alumine, 7 of sulphate of potash, and 44 of water; and is therefore improperly termed *Sulphate* of *Alumine.* It crystallizes artificially in the regular octohedron.

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* *Alum.* Native Alum has been found in various places in the United States. It ſometimes appears to follow the decompoſition of pyrites, and at others to be formed without. Occaſionally ſmall quantities are gathered in a ſaline ſtate, after the evaporation of the water in dry weather.

It seems scarcely decided whether Alum is or is not a natural production, in so singular a manner is it enveloped in the mineral substances which contain it, or from which it is procured, or produced. From several of these it is procured merely by their exposure to the operation of the atmosphere upon them; thus far, therefore, it may be esteemed a natural production; and as it is largely met with in certain volcanic countries, it has an equal claim with many other substances to be considered as a mineral.

Alum is found in, or procured from, at least three earthy substances of somewhat different external characters, which are described as alum earth, alum stone, and alum slate.

Alum Earth is of a brownish black colour, occasionally with a glimmering lustre, owing to the intermixture of mica; its fracture is earthy, somewhat inclining to slaty; and it is light, soft, and friable. It occurs, frequently, in beds of great magnitude, in alluvial land, and sometimes in the flœtz-trap formation; and is met with in Bohemia, Saxony, Austria, Naples, Hungary, and in the Vivarais in France.

Alum is procured by lixiviation from alum earth, which seems to be considerably bituminous, and has a strong resemblance to bituminized wood; when left exposed to a moist atmosphere, it becomes warm, and at length takes fire: occasionally, it is used as fuel.

Alum stone is greyish, or yellowish white, of various shades: it occurs in considerable masses which are translucent at the edges, somewhat hard and brittle; it adheres slightly to the tongue, and gives out an argillaceous odour when breathed on.

It is met with only at La Tolfa, in the states of the church, in Tuscany, and in Upper Hungary: at La Tolfa the alum-stone is found in large strata, and in large masses, among compact iron-shot argillaceous limestone, and is mixed with lithomarga, fluor, and calcareous spar; and penetrated by veins of quartz. In Hungary, pyrites, native sulphur, and quartz, are often found dispersed through it. The pure Roman Alum is prepared from it.

Alum-slate is of a greyish, bluish, brownish, or iron-black colour, and sometimes irridescent on the surface; its structure is slaty, and it is soft, brittle, and has a meagre feel; by exposure to weather, it falls to pieces, and is covered by an efflorescence, often somewhat bituminous. By one analysis, it consists of alumine 44, sulphuric acid 25, silex 24, potash 3, water 4. It is found in round masses, in beds and strata, more rarely in veins, in the newer argillaceous schistus, and also in transition mountains. It occurs in Saxony, Bohemia, Hungary, France; also in the valley of the lead hills in Scotland, in the mountains near Moffat, and in the transition rocks of the south of Scotland. At Whitby, in Yorkshire, there are very extensive alum works; but the nature of the earth or rock from which the Alum is procured, or its geological situation, has not been accurately described.

Alum can only be procured from alum-slate by burning it.

Alum is rarely found massive; that which is met with in the island of Melo, most nearly approaches to this character; if taken away, it shortly appears again, whence it is supposed to be merely close aggregations of efflorescences. The mines of Melo are volcanic; there are also other volcanic mines, as of Latera, near Bolsena, in Italy, also at Solfaterra: those of Tolfa, above-mentioned, are likewise by some considered to be volcanic, while others assert that the beds of La Tolfa may be traced to the Apennines. Mines of Alum, in volcanic countries, are situated in whitish or reddish friable lavas.

Alum is likewise found in the waters of a few springs, as of those of Stikkenitz in Bohemia, and of some in Hungary.

CRYOLITE.

Of this rare mineral, which has only been brought from Greenland, the Geological history is not known. It occurs massive, white, or greyish white, and occasionally brown, from an admixture of iron, and may be fractured into rectangular parallelopipeds: it is not so hard as fluor spar, and is translucent; but by immersion in water, it becomes transparent. The name of Cryolite was given on account of its easy fusibility; it fuses, and becomes liquid before the blow pipe: and even in the flame of a candle. Its specific gravity is 2.94; and it consists of 21 of alumine, 32 of soda, and 47 of fluoric acid and water.

LIME.

Lime has never been found pure; when so prepared by the chemist, it is white, moderately hard, of a hot acrid taste, and infusible except by voltaic electrity.

It is not a simple or elementary body; but a compound, consisting of oxygen united with a base which possesses the colour and lustre of silver; but which Sir H. Davy has not hitherto been able to examine: he considers it to be a metal, and has denominated it *Calcium.* Berzelius estimates Lime to consist of about 28 per cent. of oxygen, and 72 per cent. of calcium.

Lime is obtained artificially, by heating the various species of carbonates, till the carbonic acid is driven off; hence the lime obtained for cements and agricultural purposes. For nice chemical purposes, it is procured in a purer state, by subjecting to a red heat, for some hours, either the white Carrara statuary marble, or oyster shells; the outer coat being first taken off. From the former, lime is obtained which is mixed only with small portions of silex, and sometimes with an atom of iron; the lime procured from the latter, contains only a little phosphate of lime. These impurities are afterwards got rid of, by chemical processes.

Lime enters into the composition of a considerable number of earthy or stony minerals, but is not found in any earthy compound in the proportion of 50 per cent. except when mineralized by an acid; thus combined, it is found in so great abundance, that some geologists have estimated that it enters into the composition of the crust of the globe, in the proportion of one-eighth of the whole.

Lime, and its natural compounds, generally speaking, are of infinite importance and utility; in which respects they are inferior to no other mineral substances, but may, on the contrary, be estimated as superior to all.

Lime is found mineralized by the carbonic, phosphoric, fluoric, sulphuric, nitric, boracic, and arsenic acids; forming carbonate, phosphate, fluate, sulphate, nitrate, borate, and arseniate of Lime; these compounds, in common with all other natural combinations of earths with acids, are, by some mineralogists, termed *Earthy Salts*.

CARBONATE OF LIME.

The numerous minerals comprehended under the term Carbonate of Lime, differ greatly in exterior characters. Scarcely more can be said of them in the general, than that they all readily yield to the knife, and that their specific gravity is below 3. Carbonate of Lime occurs crystallized, fibrous, foliated, granular, compact, and earthy. When crystallized, it is termed *Calcareous Spar*, from the Latin, calx, lime; when granular or compact, *Limestone*.

*Calcareous Spar** is often extremely pure carbonate of lime, and is frequently very transparent, when it is strongly double refractive. Its colours are very various, and it is found crystallized in upwards of 300 varieties of form, all originating from an obtuse rhomboid of 105° 5′ and 74° 55′; this rhomboidal may be readily obtained by cleavage; and the brilliant surfaces of the fragments are well adapted to the use of the reflecting goniometer. It is not often found in the form of its primitive crystal, which nevertheless has been met with in several parts of England. It is extremely subject to that species of crystallization which is known by the term macle, or, according to Haüy, hemitrope. Calcareous spar is not

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* Rhombic Calcareous Spar fills the veins of ſchistic rock, at Battenkill and that vicinity, in Waſhington co. N. Y. where it is probably primitive.

Primitive carbonate of lime forms a ſtratum reaching from Sunderland in Vermont, through the weſtern border of Maſſachuſetts, almoſt to New York city. Of theſe, the magnificent City Hall, in New-York, is built, from ſome of the quarries, or rather layers, it is of that open and granular conſtitution which enables it to be bent, making thereby elaſtic marble. There is a ſlab of it in New-York, about 6 feet long by 3 broad, and between 2 and 3 inches thick, which can be bent to a meaſurable curve.—It may be ſhaken backward and forward at the middle, while the two extremities are faſt. It imbibes water readily; and when this water freezes, the ice ſtiffens the ſtone, and impairs, to a conſiderable degree, its elaſticity.

The Marble of Singſing and of Weſt-Farms, in Weſtcheſter county, is alſo a primitive rock, and is mixed with ſo much ſilex that it is hard to work and to poliſh.

The Iſland of New-York, near Kingsbridge, affords a compact marble, that is now employed in architecture. It is white and granular, and frequently gives fire under the ſtroke of the hammer. In ſome places, it is penetrated by brilliant pyrites. In ſome ſpots, the grains are as large as the particles of coarſe ſalt, and they fall aſunder ſpontaneouſly, or with the gentleſt motion. Some of the ſtrata of the quarries afford excellent quick lime.

The extenſive ſtrata of Lime-ſtone beginning in Poughkeepſie, and penetrated by the Hudſon at Barnegat, north of Newburgh, afford great quantities of excellent lime; and may be ranked as of tranſition formation.

Secondary Limestone is a calcareous carbonate of very great extent in the Fredonian States. It occupies great ſpace in the vallies extending from north-east to ſouth-west from New-York to Alabama: and it conſtitutes vaſt and wide extended layers on the north-weſt of the great dividing Ridges, from Canada to Louisiana. It is ſometimes excavated in caverns of great ſize, as in the Helleberg weſt of Albany; as at the ſouth of the Kaatskill near Eſopus; as in the valley of the Shenandoah, Virginia, and above all near the green river, in Kentucky. Perhaps this latter is the moſt extenſive in the known world. It is figured and deſcribed in Med. Repos. Vol. 17. p. 393.

Stalactites abound in theſe ſubterranean receſſes, and are often exceedingly large and beautiful.

The remains of marine animals, ſuch as ſhell-fiſh, or teſtaceous molluscas, abound in theſe rocks, proving inconteſtibly the former dominion of ſalt water, over theſe extenſive regions before the ancient barriers gave way and shrunk the ancient ſea of the interior to the comparatively diminutive lakes. On the ſubſidence of the ſalt water, the land to a great extent, was laid bare, and the lakes gradually changed to freſh water. The facts and reaſoning in favour of this opinion, too long for inſertion here, may be ſeen in my Memoir on the Geology of North America, publiſhed at New-York in 1818.

Many beautiful marbles are found in our country. The quarries of Bennington and its vicinity in Vermont; of Stockbridge and its neighbourhood in Maſſachuſetts; of Kingſbridge and its contiguity in New York; of Norriſtown, and the adjacent region in Pennſylvania; of Fredericktown and the bordering region in Maryland; and of Milford in Connecticut; are among thoſe which furniſh marble of various and elegant qualities for the architect.

The breccia of which the pillars of the Capital at Waſhington, are now preparing, poſſeſſes a character as worthy of the eye of the mineralogiſt, as of the connoiſſeur. It is an aggregate of ſmall calcareous water-worn ſtones, of all ſhapes and colours, conglutinated by a calcareous cement into a rock of perfect ſolidity. From theſe maſſive layers the material is broken up in any ſhape and ſize that is required. It is as variegated and elegant as any breccia that Italy, Sicily, or any other place affords.

Some of the Calcareous Carbonates, that abound in ſhells, have been worked into *Lumachelle* Marbles. The variety of animal relicks that ſome of them contain, is very remarkable, as in that found at Coeyman's Patent, in Albany County. But few or none of them hitherto diſcovered, so hard as fluor spar: its specific gravity is 2.7: it consists of 57 per cent. of lime, and 43 of carbonic acid. That of Iceland, which is considered to be the purest form of carbonate of lime, is transparent, and double refractive in a high degree. It is familiarly termed *Iceland Spar*, or *Double refracting spar*. Some varieties of calcareous spar, especially these from Derbyshire, become phosphorescent when laid on a hot coal.

It occurs in veins in almost every kind of rock, from the oldest, to the newest alluvial strata, and accompanies, or constitutes the gangue of a great variety of minerals; and sometimes it appears in strata, between the beds of calcareous mountains. It is so generally distributed, that it would be impossible to give a list of its localities. The rarest and most beautiful crystals are found in the northern parts of England; from which were obtained a very considerable number of the vast variety described by the Count de Bournon.

Stalactitic carbonated lime, the *Calc sinter* of Jameson, is of various colours: the most common of which is yellowish white. Stalactites are deposited from water loaded with particles of carbonated lime, in the hollow places and caverns of mountains: the water, finding its way into these caverns through crevices in the roof, becomes exposed to the air; evaporation ensues, causing particles of lime to precipitate. These stalactites are sometimes solid, having a lamellar structure; but sometimes are of a fibrous texture, radiating from the centre to the circumference, as may be observed when they are

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curious and intereſting as they are to the Geologiſt, are capable of the ſplendid poliſh which fits them for the nice purpoſes of building. In time, it may be expected that ſuch will be found.

Fetid Lime ſtone abounds in the United States. It conſtitutes very extenſive ſtrata. The falls of Niagara roll over it. Madrepores, orthocerites, anomias, oyſters and pectens, are frequently found in it, as is a ſort of black flint or hornſtone.

I have ſpecimens of a coarſe chalk from the neighbourhood of St. Stephens, on the Tombigbee River. Bivalve ſhells and ſea-urchins, of ſeveral ſpecies, are ſeen in their ſtages of converſion into lime-ſtone, marle and chalk.

Calcareous marle is formed from marine ſhells, in the bays and coves on the ſouth-ſide of Long-Iſland; and from freſh-water molluſcas in the holes and ponds of Orange and Ulſter Counties, adjacent to the Wallkill, New York.

broken. The precise mode of their formation does not seem to be understood; some are extremely thin tubes, which has caused the suspicion that, at least some of those which are solid, are filled within; some increase externally, and are covered by minute crystals, or are terminated in a manner somewhat resembling a mushroom.

Stalactites are sometimes of prodigious dimensions, and very numerous; of which the grotto of Antiparos, in the Archipelago; the Woodman's Cave, in the Hartz; the Cavern of Castleton, and other caverns in Derbyshire, and that of Auxelle in France, are remarkable instances.

Some caverns have been entirely filled with calcareous Stalactite, so that it is occasionally obtained in large masses; in this state it is called *Oriental Alabaster*, and is much used in statuary and in the formation of vases: it was greatly employed by the ancients. That which was brought from the mountains of Thebais, situated in Egypt, between the Nile and the Red Sea, from near a village called Alabastron, was much prized: a nearly collossal figure of an Egyptian idol, formed of this alabaster, was in the museum (ci-devant Napoleon) at Paris.

Stalactites are not always very pendulous; sometimes they are of a botryoidal form. The flat or tabular portions formed on the floors of caverns, by deposition from the water dropping from the roof, are called *Stalagmites.*

Fibrous Carbonate of lime, familiarly, from its chatoyant lustre, termed *Satin Spar*, is composed of fine parallel fibres. It occurs near Alston-moor, in the north of England, in strata from one to four inches thick, accompanied by veins of pyrites, in a brown schist. It is susceptible of a fine polish, and is employed in inlaying, and in the manufacture of necklaces in imitation of pearl. Fibrous carbonate of lime is also found at Bergère in France.

Schiefer Spar, the *Slate spar* of Jameson, occurs massive, having a straight, or undulated foliated structure; it is white, with a remarkably pearly lustre, and translucent.

It is considered to belong to primitive countries. It is generally found in chlorite, with sulphutre of zinc and of lead. It occurs in the Vosges, near St. Marie aux Mines; at Bermsgrün, near Schwartzenberg in Saxony; at Kongsberg in Norway, &c. It was also found in a tin vein traversing argillaceous schistus in Polgooth mine in Cornwall, accompanied by tin and chlorite; sometimes it passed into lamellar and nearly transparent carbonate of lime.

Aphrite. This mineral is only found in a friable state, and consists of white scales of a shining pearly lustre, and very soft to the touch. It is termed by Werner, Schaumerde (Earth-foam) and is by him considered to be nearly allied to Schieffer spar: it is usually found in calcareous rocks.

It occurs at Gera in Misnia, and more abundantly at Eisleben in Thuringia, in mountains consisting of stratiform limestone.

Agaric Mineral is of a white colour, or yellowish or greyish white; and is soft, very tender, opake, and is so light as to float for a short time on water. It is considered to be nearly pure carbonate of lime. It is found in the beds and crevices of calcareous rocks in Switzerland, where it is employed to whiten houses. It is also found near Ratisbon; likewise at Sunderland in the county of Durham.

Granular Limestone is massive, and composed of small grains which are of a lamellar texture and brilliant lustre; but as these grains intersect each other in every direction, the lustre of the mass is only glimmering. It is of various colours; the whitest and most esteemed, from its resemblance to sugar, has been termed by the French mineralogists, chaux carbonatée saccharoïde; but it has more generally, from its important uses in the arts, obtained the name of *Statuary Marble.* Granular limestone is also called *Primitive Limestone*; the largest grained is generally esteemed to be of the oldest formation. Its colour varies from white, through various shades of yellow, green, grey, blue, red, almost to black; and it is sometimes clouded, spotted, or veined: it is translucent at the edges, and is very brittle. It never encloses the remains of organized bodies, but frequently contains certain other substances dispersed through its masses; as quartz, garnets, mica, hornblende, talc, actinolite, asbestus, sulphuret of zinc and of lead, magnetic iron, &c.

Granular limestone is found in many, if not most primitive countries; it sometimes forms entire mountains, but more often occurs in beds. It is considered to be of contemporaneous formation with gneiss, porphyry, argillaceous and micaceous schistus, with which it frequently alternates. In the Alps, and especially the Pyrenees, examples of this are of frequent occurrence. In the peak, on the south of Bagnère, in the Pyrenees, vertical beds of granular limestone alternate with beds of granite.

The most celebrated statuary marble was found in the island of Paros, thence termed *Parian marble;* the marbles of Naxos and Tenos, were also called by the same name, being both almost equally valuable for the purposes of the statuary; the quarries of those islands are said to be quite exhausted. Parian marble is white, large grained, and considerably translucent; it was called by the ancients *Lichnites.* The celebrated statues of the Venus de Medicis, of the Venus Capitolini, of the Pallas de Velletri, and many others, are of this marble. The statutary marble called by the ancients *Marmor Pentilicus,* was taken from quarries on a mountain called Pentelicus, near Athens: it is traversed by greenish or greyish veins, which are commonly micaceous. Of this marble, the head of Alexander, the Indian Bacchus, the statue of Esculapius, the head of Hippocrates, &c. were made. The marble of *Carrara* or of *Luni,* is of a much finer grain, and closer texture, than the foregoing; and is now usually employed by statuaries: the quarries of this marble are on the eastern coast of the gulph of Genoa. Among many other celebrated statues made of this marble, are the Antinous of the Capitol; a colossal bust of Jupiter, &c.: and Dolomieu is of opinion that the Apollo Belvidere is of Carrara marble, but the marble-merchants of Rome consider it to be of an ancient Greek marble, differing from any now known. Dr. Clarke remarks, that the Carrara marble is milk white, and less crystalline than the Parian; that the Parian is whiter and less crystalized than the

Naxian; and further, that while the works executed in the Parian marble retain, with all the delicate softness of wax, the mild lustre of their original polish, those which were finished in the Pentelican marble have been decomposed; and sometimes exhibit a surface as earthy and as rude as common limestone, owing to the veins of extraneous substances which intersect the Pentelic quarries. Statuary marble was anciently brought also from many other places besides those abovementioned: it is now found in Saxony, Bohemia, Norway, Sweden, England, France, &c.

Of marbles, there is an almost endless variety. Those most esteemed for ornamental purposes, as for chimney pieces, &c. are brought from Spain, and the Pyrenees, and from Italy. The environs of Verona are quarried in every direction. Many marbles consist almost entirely of shells; it is to be regretted that no precise account is to be found of the many beautiful varieties abounding in almost every country. Those of our own country are scarcely noticed beyond the limits of the districts in which they occur, although many varieties are admirably adapted to ornamental purposes.

In Derbyshire there are two quarries of marble of a deep uniform black colour and without shells; one of them is situated at Hadden, the other at Ashford, and both are near Bakewell; the former belongs to the duke of Rutland, the latter to the duke of Devonshire; both the marbles are largely employed for the purposes of chimney pieces and ornaments, of which the manufactory is carried on by Brown & Co. at Derby; who have fixed up in their ware-rooms a large slab to be used as a looking-glass; of so high a polish are those marbles susceptible.

Near the Peak in Derbyshire, a marble is quarried, which consists almost entirely of fossil shells, chiefly of entrochi; this marble is used for chimney pieces.

At Wetton, near Ashbourn, in the same county, a beautiful variety of marble is quarried, which is of a greyish black colour, and contains a vast number of very minute shells of a whitish colour, giving to the mass very much the appearance of porphyry. This is used for the same purposes as the black marbles above mentioned.

Near Kendall in Westmoreland some varieties of black and grey marbles are quarried; which have some resemblance to some of the Derbyshire marbles, and are employed for the same purposes.

At Babbicombe in Torbay, in Devonshire, is quarried one of the most beautiful marbles in existence; its colours vary from a light brown to a deep red, which are finely variegated. This marble is extensively manufactured into chimney pieces in the west of England; an attempt was lately made to introduce this beautiful marble in London; but the marble not being foreign, it failed of success.

In Durham, Buckinghamshire, and other counties of England, other marbles of less note are quarried.

At Kilkenny in Ireland, a marble is found of a fine black, enclosing shells of a whitish colour, which, when the marble is cut and polished, exhibit segments of circles. This marble is much used for chimney pieces and ornaments.

Two or three varieties of marble commonly found in mineralogical collections, deserve a slight notice, though somewhat out of place.

The *Verd Antique* consists of carbonate of lime imbedded in green serpentine: its geological situation is not known.

For *Ruin marble*, see Index.

The *Lamachelli marble* exhibits beautiful irridescent colours, which are sometimes prismatic internally, but more commonly of various shades of red or orange, whence it has also obtained the name of *Fire marble.*—It is found in veins at Bleyberg in Carinthia. Its colours are attributed to the shells of a variety of nautilus.

The *Cottam marble*, found near Bristol, which exhibits when cut and polished, the appearance of a landscape, consists of carbonate of lime mixed with a large proportion of argillaceous matter.

Common, or *Compact, Limestone* is in great degree allied to marble; it is fine grained, solid, and generally susceptible of a polish, which, as well as its colour, is duller than that of marble. Its fracture is earthy, or flat conchoidal; more rarely splintery. Its colours are various; yellowish-white, grey, brown, reddish, or bluish, of different shades. Two or more of these colours often occur in veins, zones, bands, &c.: it frequently exhibits appearances of arborizations. It is translucent on the edges, hard, and brittle. Its specific gravity is 2.6. Compact limestone usually contains small and variable proportions of silex, alumine, of the oxides of iron and manganese, and sometimes of inflammable matter.

Some varieties of compact limestone, and of marble, properly so called, or granular limestone, are not often found enclosing organic remains; these are therefore considered to be of early formation. Werner considers marble as a transition rock, compact limestone, as a floetz rock; their age is characterized by the fossils they contain: the older contain ammonites, belemnites, gryphites, &c.; the newer, abundance of such marine shells as are now found in the sea, and the remains of fish.—Both these rocks are found in thick beds parallel with each other, though rarely horizontal; more frequently, nearly vertical. They are found together, forming a chain of stratified mountains, in the Pyrenees, above 10,000 feet in height. The summits of these mountains are rarely pointed, being mostly flat and of considerable breadth, with very steep sides, to a prodigious height. These appearances are remarkable on the edge of the Alpine, and in the centre of the Pyrenean chain, especially near Grenoble. Compact or granular limestone, encloses beds or masses of red oxide of iron, of sulphuret of mercury, sulphuret and molybdate of lead, manganese, oxide and sulphuret of zinc, &c. These metals are also found in veins passing through these rocks, together with lamellar carbonate of lime, iron pyrites, malachite copper, &c. Garnets and steatite are occasionally, though rarely, found disseminated in these rocks. Brongniart mentions having seen flint imbedded in compact limestone, near Bakewell in Derbyshire.

The uses of compact limestone for building, paving, &c. and when deprived of its carbonic acid, for cements and the purposes of agriculture, are well known.

The houses of Paris are built of a large grained and soft calcareous stone, which is incapable of polish, and is of a dingy white, grey, or yellowish white colour. It is found in immense horizontal beds, forming the plains south of Paris. It is a very impure limestone, and furnishes, when calcined, a very bad lime. The use to which it is put, has occasioned its receiving the familiar name of *Pierre à bâtir*. Haüy describes it under that of Chaux carbonatée grossière. Its geological situation is between chalk and gypsum ; it is above the chalk, from which it is separated only by a bluish plastic clay, as may be seen at Meudon. This variety is said to be almost peculiar to France.

Swinestone, or *Stinkstone*, so called from the strong fetid odour given out when scraped or rubbed, is found massive and compact, and of various shades of grey, brown, and black. By calcination it becomes white, and burns into quick lime. The offensive odour which it gives out when scraped, is considered to be owing to its including sulphuretted hydrogen : it is commonly attributed to bitumen, which does not seem to enter into the composition of Swinestone.

The harder and more compact varieties, which receive a good polish, are used in ornamental architecture.

It is said to occur forming whole mountains; it is more commonly found alternating with strata of gypsum, or of compact limestone. It occurs in Germany, France, and most other countries : in Shropshire and Northumberland in our own : the Cliffs on each side the Avon at Clifton near Bristol are in part or wholly composed of it.

Bituminous Limestone is brown or black, which colours are supposed to be owing to the bitumen it contains : its structure is sometimes lamellar ; sometimes compact, when it receives a good polish ; when rubbed or heated it gives out an unpleasant bituminous odour ; by the continuation of heat, it loses both colour and odour, and burns into quick lime.

It belongs to secondary countries, and is sometimes found in coal formations, as in Galway in Ireland, where it is employed as a combustible. In Dalmatia it is so bituminous that it may be cut like soap, and is employed in the construction of houses ; when finished, they set fire to the walls ; the bitumen burns out, and the stone becomes white ; the roof is then put on, and the house afterwards completed.

Oolite, or *Roe-stone*, so denominated from the resemblance between the little round masses of which it is composed, and the roe of a fish, is always found massive, and in beds, whose geological situation is between sandstone, common limestone, and gypsum. The globular particles are sometimes composed of concentric lamellæ, and usually adhere by means of a calcareous cement. The Roe-stone is very soft when first quarried, but hardens by exposure to the air. Its colour is whitish, yellowish white, or ash grey, depending, as it is believed, on the quantity and quality of the argillaceous matter with which it is usually combined. It is a very impure carbonate of lime, and will not burn into quicklime.

The houses of Bath are for the most part built of this mineral. The Ketton-stone, and, by some, the Portland-stone, is considered to be a variety of Roe-stone. It is also found in Sweden, Switzerland, abundantly in Thuringia in Saxony, and near Alençon in France.

It is sometimes used as a marl for agricultural purposes. It was heretofore supposed actually to consist of the roes of fishes, petrified : the cause of its singular formation is not understood. Daubenton, Saussure, Spallanzani, and others, suppose it to have originated in small grains of carbonated lime, which received additional coatings by the movement of the waters which contained it.

Pea-stone, or *Pisolite*, differs from the roe-stone both in colour and structure ; it is generally white, and is composed of round or spheroidal masses, from the size of a pea to that of a hazel nut, imbedded in a calcareous cement : these masses always consist of concentric lamellæ, in the midst of which is uniformly found a grain of sand. It is less abundant than the Roe-stone.

The waters of Carlsbad in Bohemia issue from the beds of the Pea stone, which is found in the waters of the brooks that supply the baths of St. Philip in Tuscany, which suffer a whirling motion in their course. It also occurs in Hungary, and at Perscheesberg in Silesia.

Madreporite is found in large, detached, roundish masses, of a greyish brown, or greyish black colour, and opake; which are composed of cylindrical, prismatic, parallel, or diverging concretions. Its name was given from its structure and appearance. It consists of 93 per cent. of carbonate of lime, together with small portions of carbonate of magnesia and of iron, carbon, and siliceous sand.

It occurs in detached masses in the valley of Rusbach in Saltzburgh. Some naturalists have supposed it to be a real petrifaction, which has been doubted by others, who are of opinion that its internal structure does not warrant the conclusion.

Chalk is usually white, occasionally greyish or yellowish white; it has an earthy fracture, is meagre to the touch, and adheres to the tongue; it is soft, light, and always occurs massive. The purest consists of carbonate of lime and water, but it more often contains variable portions of alumine or silex.

It is one of the newer secondary rocks, and wherever found is alway the prevailing substance, forming hills of three or four hundred feet in elevation, which are remarkable for the smooth regularity of their outline. Chalk is far less abundant in nature than compact limestone. The countries in which it is principally found, are Poland, France and England; most abundantly in the latter, forming long continuous hills, in the direction nearly of east and west, and separated by ranges of sandstone, and low tracts of gravel and clay.

Of Chalk there are two formations, the upper and the lower; the latter is without flints; the former, whatever may be its elevation, is characterized by containing parallel and horizontal layers of flints. Chalk, likewise, contains abundance of the remains of marine organic bodies, and of amphibious and land animals.

The uses of Chalk are numerous: when compact it is used for building; it furnishes lime for cements and manure; it is employed in the polishing of metals and of glass; by mechanics, as a marking material, and as moulds to cast metals in; by chemists and starch-makers, to dry precipitates on, for which it is peculiarly qualified by the facility with which it absorbs water. It is the white of distemper painting, and, when washed and purified, forms the substance termed whiting.

Marl. Of this substance there are many varieties: some of them effervesce strongly with acids, and are employed as manures: they vary much in respect of colour, and are greyish or yellowish, bluish or reddish. Marl, in the general, is massive, but falls to pieces by exposure to the air, when it becomes plastic in water. Calcareous marl, of an earthy texture, occurs in beds in secondary limestone, and often contains shells; it is found in most calcareous countries; occasionally in coal formations. It is sometimes found of a slaty structure and bituminous, when it is termed *Bituminous Marl Slate*, or *Marlite*; which occurs in beds with the oldest flœtz limestone, intermixed with the ores of copper: in Thuringia extensive works are employed in the smelting of the copper it contains. It is remarkable that a large number of fish of the same species, are also contained in this substance in regular layers; the bodies of which are carbonized, or are converted into coal, and sometimes their scales are plated with copper ore; but every fish is in a contorted position, as though it had undergone violent death by a sudden irruption or deposition of sulphureous and metallic matter: accompanying the fish, are found petrified plants, which appear to belong to the genus, fucus.

Tufa is the most impure, the most irregular, and the most porous of all the varieties or carbonate of lime. It is light, cellular, and often incrusts other substances. The various articles which, being placed in certain springs, or waters, in Derbyshire, become covered by an earthy substance, and which thereby acquire the external appearance of petrifactions, are in fact, only incrusted by a kind of Tufa. It is sometimes sufficiently massive to be employed as a building stone.

It generally occurs in alluvial land, and is found both in Essex and in Derbyshire.

ARRAGONITE.

The Arragonite, so called from its having been first discovered at Arragon in Spain, is commonly found in six-sided crystals of a greyish, or greenish white, and of various shades of brown; sometimes of a brownish red colour. The crystals, however, are not perfect prisms; down the centre of each lateral plane, there generally runs a seam, which is considered to be owing to the peculiar construction of the crystal. The Count de Bournon considers this substance as a hard carbonate of lime; it readily scratches the common carbonate, and sometimes glass; and he conceives that the six-sided prism of the Arragonite is derived from the rhomboid, which he imagines to be the common primitive crystal, of Arragonite and the carbonate of lime; but he shows that the six-sided prisms of these substances cannot be derived in the same manner from the rhomboid, because they cannot be cleaved in the same directions. Haüy, on the contrary, considers the primitive form of the crystal to be a rectangular octohedron. The Arragonite is sometimes seen in crystals, which appear to be elongated octohedrons, crossing each other at right angles.

Like the common carbonate of lime, the arragonite possesses a double refraction; but differs from it, in being somewhat heavier, of an imperfect lamellar structure, and considerably harder.

These circumstances are sufficient to render the identity of Arragonite and common carbonate of lime doubtful; nevertheless Vauquelin, Klaproth, Chenevix, &c. have not discovered any difference in their component elements; but Stromeyer by three analyses discovered from 2 to 3 per cent. of strontain involved in its composition.

In Arragon, in Spain, it occurs disseminated in a ferruginous clay, accompanied by sulphate of lime: at Leogang, in Salzburg, in an argillaceous or a quartoze rock, accompanied by calcareous spar, yellow copper, and arsenical pyrites. It has also been found in the cavities of basalt near Glasgow. The greenish varieties are brought from Marienberg in Saxony, and Sterzing in the Tyrol. It is also met with at Bastan and Caupenne, in the lower Pyrenees.

The Arragonite is also found *acicular*; either in slender diverging, or in parallel fibres. It occurs in radiated masses, terminated by crystals, in the fissures of a compact basalt, at Vertaison, in the department of Allier, in France.

The substance termed *Flos Ferri*, because it was originally found in mines of spathose iron, is now considered to be a variety of Arragonite ; though for what reason it is difficult to say, as it has never been analyzed. It is usually of a snow white, and either in small branches which are strait, or bending in various directions, having commonly an external silky lustre, arising probably from the crystalline terminations of the minute fibres of which it is composed ; these fibres radiate from the centre, presenting, when the substance is broken, a brilliant silky lustre.

The finest specimens are brought from the mines of Eisen-ertz in Stiria : it occurs also at Schemnitz, at St. Marie aux Mines, and in the mines of Baygorri and Vicdessos in the Pyrenees. Small, but beautiful specimens have also been brought from Dufton in Westmoreland.

BITTERSPAR.

Bitterspar is usually found in crystals in the form of its primitive crystal, the rhomboid, which is so nearly allied to that of the carbonate of lime, that it was considered to be the same, until Dr. Wollaston discovered the difference by means of the reflecting goniometer. Its angles are 106° 15′ and 73° 45′. The colour of this mineral is yellow, with a somewhat pearly lustre ; and it is harder than carbonate of lime, is semi-transparent, and very brittle. That from the Tyrol consists of 52 carbonate of lime, 45 carbonate of magnesia, and 3 of oxide of iron and of manganese.

It is commonly imbedded in chlorite, steatite, or serpentine ; and is found in the mountains of the Tyrol and of Salzburg ; in that of Taberg in Sweden, and on the borders of Loch Lomond in Scotland.

A variety found in compressed hexahedrons, or in small masses of a light green colour, by Dr. Thompson, at Miemo in Tuscany, thence called the *Miemite*, occurs in the cavities of alasbaster. It consists of the same elements as the former variety, in about the same proportions.

A variety in the form of somewhat oblique tetrahedral prisms, was found at Gluckbrunn in the territory of Gotha. The proportions of the component elements differ from those of the preceding varieties.

BROWN SPAR. PEARL SPAR.

The *Brown Spar* is of various shades of grey, brown; sometimes reddish brown. It occurs crystallized in varieties of the rhomboid, which, as its primitive crystal, differs somewhat from that of the carbonate of lime or the bitterspar, as was discovered by Dr. Wollaston by means of the reflecting goniometer. Its angles are 107° and 73°. The fracture of massive Brown Spar is curved-foliated; rarely perfectly lamellar: it is translucent on the edges: it contains a very variable proportion of iron. Some varieties greatly resemble spathose iron.

It is commonly found in veins, accompanied by quartz, carbonate and fluate of lime, lead, zinc, iron, silver, &c. It occurs in the Pyrenees, Saxony, France, Sweden, &c. At Ormes-head in Caernarvonshire, it occurs in veins with copper and manganese, and very abundantly in mass.

Pearl Spar is white, greyish or yellowish white, and occurs in rhomboids usually with curvilinear faces; sometimes of a pearly lustre which is remarkably brilliant, from which it obtained its name: it occurs in nearly the same places and under the same circumstances, as Brown Spar; and is abundant in some of the mines of the north of England. That of Sweden, consists of 29.97 of lime, 21.14 of magnesia, 44.6 of carbonic acid, 3.4 of iron, and 1.5 of manganese.

DOLOMITE.

The Dolomite mostly occurs massive, but is sometimes of a slaty texture; it consists of fine grains, which are lamellar; the mass is generally white, occasionally with a tinge of yellow or grey; it is soft, yields to the nail, is translucent on the edges, and when struck, most ly emits a phosphorescent light, which is visible in the dark. It greatly resembles primitive limestone, but is much softer. That of the Apennines consists of 59 carbonate of lime and 40 carbonate of magnesia; that of St. Gothard contains some oxide of iron and of manganese.

It occurs only in primitive mountains, in veins or beds, accompanied by iron, zinc, orpiment, yellow copper, mica, &c. To the intermixture of this latter substance in Dolomite, its occasional slaty texture is owing. It is found at Mont St. Gothard in the Alps; and at Simplon in the valley of Kanter; and in large veins traversing granite near Varallo, in the valley of Sesia: it also occurs in Siberia.

MAGNESIAN LIMESTONE.*

The Magnesian limestone differs from common limestone in its external characters, in having generally a granular, sandy structure, a glimmering or glistening lustre, and in being of a yellowish colour. It consists of about 30 of lime, 21 of magnesia, 47 of carbonic acid, 1 of clay and oxide of iron.

It occurs in strata at Bredon hill near Derby; at Matlock in the same county. A great range of hills extending from Nottingham to Sunderland, overlaying the coal, are entirely composed of it; it forms beds in the Mendip hills in Somersetshire; it occurs at Ballyshannon in Ireland, and at Houth, near Dublin. The Minster and city walls of York are built of magnesian limestone; sometimes, though rarely, it contains shells, &c.

The lime obtained from it is greatly esteemed for cements, being less subject to decay, owing to its absorbing less carbonic acid from the atmosphere than the lime of common limestone. But for agricultural purposes it is less esteemed; when laid on particular soils it tends rather to injure than to improve vegetation; which is wholly destroyed when the quantity is large: this effect is owing to the magnesia it contains. An immense tract of chalk in France is wholly divested of vegetation, owing to its containing about 11 per cent. of magnesia.

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* *Magneſian Minerals* are frequent in and around New-York. There is reaſon to doubt the aſſertion that magneſia renders the ſoil barren. Was this the fact, New York iſland, Staten iſland and Hoboken ought to feel the bad effects of it; which does not appear to be the caſe.

LIAS. CALP. ARGILLO-FERRUGINOUS LIMESTONE.

Argillo-ferruginous Limestone is found massive in beds, or in globular and spheroidal masses, traverses by veins of calcareous spar. It is tougher than common Limestone, and is of a bluish black, (blue Lias) or greyish blue colour (white Lias); it has an argillaceous odour when breathed on, and when burnt is of a buff colour. Calp is composed of 68 per cent. of carbonate of lime, 18 of silex, 7.5 of alumine, 2 of oxide of iron, 3 of carbon and bitumen, and 5 of water.

It is quarried at Leixlip near Dublin, (Calp of Kirwan) and occurs in beds at Aberthaw in Glamorganshire, whence it has obtained the familiar name of *Aberthaw Limestone.* The name of Lias, which originally was provincial, has of late been much adopted by mineralogists. The blue and white varieties alternate with each other, generally, in thin beds. The Lias encloses ammonites ,and great variety of sea shells; and is remarkable for containing the remains of crocodiles at Lyme in Dorsetshire. Its geological situation is under the Oolite, near Bath, and above the red marl, as in some parts of Somersetshire. It occurs in spheroidal masses in the blue clay of the Isle of Sheppey, and of Highgate Hill, &c. When burnt, it forms a cement, which has the property of setting very strongly under water, and for this reason was used in constructing the Edystone Lighthouse.

Lias has of late been employed in a manner which merits notice, as being a branch of the curious and important art of multiplying copies of drawings or of penmanship. A drawing is made on prepared paper with a peculiar ink. A slab of Lias, perhaps an inch thick, is then heated, the drawing is placed upon it, and both are passed through a rolling press. The paper is afterwards wetted, and washed from off the stone; but the ink, being of a gummy or glutinous quality, becomes in part absorbed by the stone, and remains. It is then ready for the printer. Previously to the taking of each impression, fresh ink is added; but the stone is first wetted with a sponge, in order to prevent the ink, which is said considerably to resemble printer's ink, and to be put on with a ball similar to that used by letter-press printers, from adhering to it: the consequence is, that it adheres only to the ink absorbed by the stone from the paper on which the drawing was originally made: paper is then placed on the stone, and both are passed through a rolling press as before. This art has been practiced in Germany with great success, though, it is said, not precisely in the same manner; the practice there, being, to make the drawing upon the stone, with a prepared ink, whence it may correctly be termed the *Lithographic Art*; the Lias of that country, is particularly adapted to it; some beautiful specimens of this art may be seen in this country. It is also said that copies of military drawings and orders were multiplied by this means, to a very large amount, at the head-quarters of the armies lately employed on the continent. An artificial composition is sometimes used instead of the Lias.

APATITE. PHOSPHATE OF LIME.

Apatite is both harder and heavier than the carbonate or fluate of lime. It occurs massive, and crystallized in the six-sided prisms, (which is the form of primitive crystals), variously terminated. The crystals in my possession, exhibit 27 varieties of form, which are extremely beautiful, and were principally brought from Cornwall. The Apatite is white, or of various shades of green, blue, red, or yellow, but not brilliant: its specific gravity is about 3. and it is composed of 53.73 of lime, and 46.25 of phosphoric acid.

The *crystallized* is chiefly met with in the veins of primitive mountains, especially in those containing tin; and it accompanies quartz, fluate of lime, sulphate of barytes, felspar, wolfram, &c. It is thus found in the mines of Saxony and Bohemia. It occurs in St. Gothard in a chlorite rock, with adularia and mica: at Stenna-Gwyn in Cornwall, in yellowish or greenish talc: near Nantes in France, it is met with in granite: and in mount St. Michael in Cornwall, in the fissures of granite, accompanied by oxide of tin and topazes.

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* *Apatite*—Apatite has been found in small maſſes, at Greenwich, City of New York. (*Jones.*)

The Apatite is commonly phosphorescent by heat, and it was remarkable that the prisms of such crystals as are not phosphorescent are terminated by six-sided pyramids, like crystals of quartz, but are less acute; the others are terminated by planes; and it is also remarkable that those which are not phosphorescent, have only been found in volcanic products: in those of Vesuvius, they accompany the idocrase; they are found at Cap de Gate in Spain, in a cellular stone, resembling lava. These crystals were heretofore termed *Chrysolites;* they are of an orange brown, or asparagus green; whence they are sometimes called *Asparagus-stone.*

Massive phosphate of lime is of a granular, fibrous, or earthy texture, and sometimes encloses a small portion of carbonate of lime. The fibrous variety is found at Schlackenwald in Bohemia, in radiated masses in tin veins: in the same veins also occur round masses, which are granular, sometimes even compact, and are phosphorescent by heat. Near Truxillo in Spain, this latter variety forms entire hills, traversed by beds of quartz. It consists principally of lime and phosphoric acid, but also contains small portions of fluoric acid, silex, oxide of iron, and water.

FLUOR. FLUATE OF LIME.*

Fluor is found both massive and crystallized; the latter has a perfectly lamellar structure, and may be cleaved with great ease into the form of the regular octohedron, which is that of the primitive crystal. The crystals are found passing into the cube, the acute rhomboid, the dodecahedron with rhomboidal planes, and the regular tetrahedron: those, in my possession, exhibit 46 varieties of form, which are extremely interesting. The colour of Fluor varies from the perfectly white and transparent, through various shades of blue, green, red, yellow, and purple, almost to black: when pounded, and thrown on a live coal, Fluor gives out a phosphoric light; when thrown, in mass, into the fire, it decrepitates and flies. It is harder than calcareous spar; its specific gravity is about 3; and it is composed of 67.75 of lime, and 32.25 of fluoric acid, according to Klaproth;—a variety analyzed by Scheele afforded 27 per cent. of water.

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* *Fluate of Lime.*—Fluate of Lime has been found in New-Hampſhire, Maſſachuſetts, Vermont, New-York, New-Jerſey, Maryland, Virginia and Miſſouri, moſtly in ſmall pieces, ſometimes looſe, and ſometimes attached

The varied colours of Fluor formerly gave rise to the now exploded names of false sapphire, false emerald, false amethyst, false ruby, and false topaz.

Crystallized Fluor is found at Mont Blanc and St. Gothard; in Saxony, Germany, and in many other countries, it occurs in veins in primitive mountains; and accompanies oxide of tin, mica, apatite, and quartz, in Cornwall, and at Zinnwald in Bohemia. It occurs in argillaceous schistus in Cumberland and Durham, with iron ore, quartz, calcareous spar, and sulphate of barytes: in Derbyshire in secondary limestone, with the last-mentioned substances, together with clay and bitumen: in limestone with galena at Beeralston in Devonshire: it also occurs in Aberdeenshire and in Shetland.

In the Odin mine, near Castleton in Derbyshire, Fluor is found in veins, in detached masses, from three inches to a foot in thickness; their structure is divergent, and their colours, as grey, yellow, blue, brown, are generally disposed in concentric bands: of this variety, called *blue john* by the miner, are made beautiful vases, obelisks, &c. by Mawe & Co. of Derby. Fluor is no where else found adapted to these purposes.

Compact Fluor is harder than common Fluor, and is sometimes of a granular texture; in general, it is translucent only on the edges: when placed on a live coal, it mostly gives out a green light: some specimens in my possession from Pednandrae mine in Cornwall, exhibit lights of various shades of green, blue, violet, and red.

Chlorophane is esteemed to be a variety of compact fluor; of which it has not perfectly the aspect. It is usually of a pale violet colour, and translucent. It does not fly in the fire, but gives out a phosphorescent light of a most beautiful emerald green colour; a specimen in my possession, from Pednandrae, gives out this light when placed in the flame of a candle; but Pallas mentions a specimen from Siberia, of a pale violet colour, which gave a white light merely by the heat of the hand; by the heat of boiling water, a green light; and when placed on a live coal, a brilliant emerald light, that might be discerned from a long distance.

Fluate of lime is commonly found in veins; sometimes in beds, but not of considerable extent; it never forms mountains, and is less abundant in nature than sulphate of lime, and very much less than carbonate of lime. The variety termed Chlorophane only has been found entering into their composition of primitive rocks: it occurs in granite in Siberia. Fluate of lime sometimes fills veins almost entirely.

Fluate of lime is principally used in the reduction of metalliferous ores, as a flux; whence its name. The fluoric acid has been used for etching on glass, in the same manner as nitric acid is used upon copper. From glass plates thus engraved, a considerable number of impressions have sometimes been taken, by great care.

ANHYDROUS GYPSUM.

It is sometimes found in eight-sided prisms, but more often massive; it is lamellar, and may be cleaved into the form of a right rectangular prism, which therefore is the primitive form. Its colours are milk white, rose, violet, or bluish; it is semi-transparent, with a double refraction, and is harder than common gypsum; it scratches calcareous spar. When pure it consists of 40 per cent. of lime, and 60 of sulphuric acid; it is sometimes called the *Anhydrite*, in reference to its being without water. Occasionally it yields a variable proportion of muriate of soda, which has occasioned its obtaining also the name *Muriacite*. The former has only been found in the salt mines of Bex in the Canton of Berne in Switzerland;

the latter only in those of Halle in the Tyrol; but in fibrous, or globular masses, or in ramose contortions (*Pierres de trippes*) it is found in some of the mines of Saxony and of Derbyshire.

Anhydrous gypsum, affording by analysis 8 per cent. of silex, and having the compact texture of certain varieties of marble, is found at Vulpino in Italy. It is of a greyish white colour, with bluish grey veins, and is translucent on the edges. At Milan it is employed for tables and chimney-pieces, under the name of *Marbre Bardiglio di Bergamo.*

GYPSUM.[*] SELENITE. SULPHATE OF LIME.

This mineral is found crystallized, fibrous, massive, and earthy. The crystallized is generally called Selenite; the amorphous and earthy, Gypsum: but these terms are sometimes used indiscriminately. The primitive form of its crystals, of which Haüy has noticed 5 varieties, is a rhomboidal prism, of 113° 8′ and 66° 52′ terminated by oblique angled parallelograms, into which the crystals may with care be reduced by fracture; the natural joints are very visible: the crystals are generally transparent, with a shining pearly lustre; and are of various shades of white, yellow, grey, brown, red, or violet colour: sulphate of lime may readily be distinguished from carbonate of lime; it is much softer, and yields easily to the nail: its specific gravity is about 2, and it is composed of 32.7 per cent. of lime, 46.3 of sulphuric acid, and 21 of water.

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[*] *Gypsum*—Gypſum is found abundantly in the counties of Madiſon, Onondaga and Cayuga in New-York, in the neighbourhood of the Salt Springs of Montezuma and Salina. It is frequently lamellar or tabular; very tranſparent and beautiful:—then it is amorphous and maſſive; in other places it is almoſt black, but becomes white by a continued red-heat. Sometimes again it is mixed with a dark argillaceous ſtuff reſembling dried mud.

Fine Gypſum of Onondaga, was found on analysis to contain in one hundred grains, 21 of water, 32 of lime and 47 of ſulphuric acid. (*Warden in Med. Rep. Vol.* 13. *p.* 77.)

At the cataract of Niagara gypſum is found in the fetid limeſtone, evidently produced by the decompoſition of pyrites. Here the newly formed Sulphuric acid combines with the lime and diſcharges the carbonic acid and hydrogene.—When picked up at the foot of the falls, in looſe and white lumps, it has been called "petrified foam."

From the bay of Fundy in Nova-Scotia, it is brought to us, in a great variety of forms, tabular, massive, in ſtellated or globular cryſtals, &c. I have ſpecimens of beautiful fibrous gypſum from Labrador.

Ten-ſided cryſtals have been brought me from the State of Ohio, where they are ſaid to lie looſe in an argillaceous ſoil.

Looſe pieces, of a fine quality, though ſmall, have been diſcovered in St. Mary's county, Maryland.

The employment of gypſum as a manure, has been and continues to be a practice of the utmoſt moment to the agriculture and produce of all the interior country. It has not been found as yet, to anſwer ſo good a purpoſe along the ſea coaſt, or in the neighbourhood of ſalt-water.

Crystallized Selenite is found at Alston in Cumberland, and in great abundance at Shotover hill in Oxfordshire. Selenite is most commonly met with disseminated in argillaceous deposites; not often in veins: but it is said to have been met with in a vein of yellow copper ore, traversing a primitive mountain, near Nusol in Hungary: in a lead vein in Bohemia; and in the silver mine of Seinénofske in the middle of the Altaic mountains in Siberia.

It occurs in remarkably long slender fibres, which are generally associated and curved *(Plumose Gypsum)*; it is found in Derbyshire, and in some of the mines of the Hartz and of Hungary. At Matlock in Derbyshire, Gypsum occurs also in straight fibres of great brilliancy, of which the cross fracture is lamellar, and of remarkable lustre.

When *massive*, sulphate of lime is termed *alabaster*, but is readily distinguished from that variety of carbonate of lime which has obtained the same name; the former yields to the nail, the latter does not. It is either granular or compact; the granular is composed of little lamellar masses, intersecting each other in every direction; the compact has a lamellar structure, and is found in the form of stalactites, at Mont Cenis, and other places.

Granular massive gypsum is found overlaying the most recent of the primitive rocks, and sometimes, it is said, is enclosed by them: its colour is mostly white; and it has been found mingled with mica, felspar, and serpentine, in Siberia; but encloses neither argillaceous matter nor organic remains: it seems therefore to have some claim for being considered as a primitive rock. In the Levantine valley near St. Gothard, it occurs between two beds of gneiss, and also at Bellinzina in the Alps: granular gypsum also occurs near Mont Cenis, and at Moutier near Mont Blanc.

Gypsum is also found accompanying carbonate of lime, and abundantly overlaying the rock salt deposites: it covers transition rocks in Scotland.

A posterior formation of gypsum, for there appears to be at least three formations, is found in horizontal beds, and is more intermingled with marl, and frequently encloses organic remains both of plants and animals, sometimes of birds, as surrounding Paris, and in other places in France.

Earthy Gypsum has very much the appearance of chalk, but is of a looser texture. It occurs near Zella and Œpitz in Saxony, and is employed as a manure.—It is constantly deposited by water in the crevices of gypseous mountains.

It also occurs in efflorescences, or in round fibrous masses, sometimes in stalactites, in the lavas of the Isle of Bourbon, and of Solfatera.

Gypsum is diffused through the water of almost every spring, to which it gives (in common with other earthy salts) the property of hardness, as it is usually termed.

Gypsum sometimes forms hills. It abounds in Switzerland, Italy, the Tyrol, in Bavaria, Thuringia, Poland, Spain; and in Derbyshire, Yorkshire, and Nottinghamshire in England; and in Pennsylvania in North America.

The uses of Gypsum are very extensive; the variety called alabaster is employed by the architect, for columns and other ornaments, being more easily worked than marble; it is also turned by the lathe into cups, basins, vases and other similar articles. The manufacture of these articles in gypsum is carried on by Brown and Co. of Derby, to a considerable extent. Alabaster is found in the neighbourhood, both white, and with veins of a reddish brown colour. The large columns employed in the building of the elegant mansion called Kedleston Hall which is in Derbyshire, are of the variegated alabaster of that county. When sulphate of lime or gypsum, is subjected to a certain heat, it loses what is termed its water of crystallization, and is converted into fine powder called *plaster of paris*; the uses of which, when beaten up with water into a paste, for taking casts of gems and statues, are well known. In some countries, especially in North America, it is largely employed as a manure.

GLAUBERITE.

This singular and rare mineral has only been found at Ocagna, in New Castile in Spain, disseminated in rock salt. It occurs crystallized, in the form of an oblique prism, whose alternate angles are 104° 30′ and 75° 30′, and whose lateral planes are transversely striated, but the terminal planes, which are of a rhombic form, are smooth and brilliant; its colour is reddish yellow or grey; it is transparent, and less hard than calcareous spar, but harder than gypsum: its spec. gravity is 2.7. and it is composed 49 per cent. of sulphate of lime and 51 of sulphate of soda. It therefore contains no water of crystallization; when immersed in water, it becomes opake.

NITRATE OF LIME.*

Nitrate of Lime is rare as a natural production; being only found in silky efflorescences on old walls; in caverns, or on calcareous rocks, in the neigbourhood of decayed vegetable matter; and in some mineral waters. Its taste is bitter and disagreeable; when prepared artificially, it is obtained in six-sided prisms, terminated by six-sided pyramids.

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* *Nitrate of Lime.*—In the States of Virginia and Kentucky there are lime-ſtone caves of great extent, abounding in a ſaltpetrous earth. This, on being lixiviated with potash, forms excellent ſalt-petre. The remaining earth carried back to the caves, is capable of being impregnated anew with the acid. And the quantity of the calcareous nitrate is so great, in theſe numerous and vaſt lime-ſtone caverns, that there is no ready means of calculating the extent to which ſalt-petre may be prepared. In time of war, it is enough for all the home conſumption and more. During the late conteſt with Great Britain, the ſalt-petre of Kentucky was brought abundantly to New York, for the Powder Mills. *See Med. Repos. Vol.* 9, *p.* 86—88.

DATHOLITE.

This rare mineral has only been found at Arendahl in Norway; of its geological situation nothing is known, but some specimens have been accompanied by greenish talc. The Datholite is greyish-white and translucent; it has been found only in ten-sided prisms, of which the primitive form is, according to Haüy, a rhomboidal prism of 109°. 28′ and 70° 32′. terminated by rhomboidal planes. The analyses of this mineral differ a little; according to Vauquelin, it is composed of 34 of lime, 21.67 of boracic acid, 37.66 of silex, and 5.5 of water.

A variety of this substance called the *Botryolite*, which is also found at Arendahl, occurs in concentric layers composed of very slender fibres; it consists of 39.5 of lime, 13.5 of boracic acid, 36 of silex, 6.5 of water, and 1 of oxide of iron.

PHARMACOLITE.

The Pharmacolite is found in minute fibrous, or acicular crystals, of a white, grey, yellowish, or purplish colour; these crystals are aggregated into globular masses, or disseminated on the sides of a vien.

It is extremely rare; having only been found at two places: at Wittichen, near Furstemberg in Germany, it is disseminated on silky or roundish masses on granite, in a vein containing cobalt, barytes, and sulphate of lime.

Its purple colour is attributed to cobalt. At St Marie aux Mines, in the Vosges, it is found perfectly white: its specific gravity is 2.6, and it consists of 25 per cent. of lime, 50.54 of arsenic acid, and 24.46 of water.

MAGNESIA.

Magnesia is a light earth of a perfect whiteness, and is absolutely insipid; it is infusible except by voltaic electricity. It consists of oxygen united with a base *Magnesium*, which is but imperfectly known, but which is considered to be a metal, and is of the same whiteness and lustre as the bases of some of the other earths.

Berzelius states magnesia to consist of about 38 per cent. of oxygen, and 62 of magnesium.

Magnesia is not, like Silex and Alumine, found in very large quantity, either nearly pure, or entering, in very great proportion, into the composition of numerous and abundant earthy substances: it is found in about thirty, in different proportions; but in most of these, magnesia is not the prevailing ingredient, though in several it exceeds 25 per cent. It is involved in a few metalliferous minerals in small quantity. It occurs combined with the carbonic, sulphuric, and boracic acids; but is found in the greatest purity in the mineral which is termed native magnesia.

NATIVE MAGNESIA.*

This rare mineral has been found only at Hoboken in New Jersey, in veins from a few lines to a few inches thick, traversing serpentine in every direction. Its colour is white, or greenish white, with a pearly lustre. It occurs in laminæ, which have a laminated texture, and are frequently disposed in a radiated position. It is semitransparent, but becomes opake by exposure; is somewhat elastic, adheres slightly to the tongue, and is soft: its specific gravity is 2.13. and from the analysis of Dr. Bruce, it appears to consist of magnesia 70, and of water 30 per cent.

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* *Native Magneſia.*—I had this mineral in my poſſeſſion for ſeveral years, without knowing what it was. Nor could I learn from any of my mineralogical friends what opinion ought to be formed of it. But we judged by external characters only. Dr. Bruce at length undertook a chemical analysis of the mineral; and proved it to be a native magneſia, or a combination in which 70 parts of magneſia were combined with 30 parts of water.

It is deſcribed by him in his American Mineralogical Journal thus: colour white paſſing into greeniſh white; luſtre pearly; ſtructure foliated; the folia or leaves frequently having a radiated poſition; the leaves when ſeparate, tranſparent; in the maſs ſemitranſparent; the ſurface after expoſure to the weather, becoming opake; ſomewhat elaſtic; adheres ſlightly to the tongue; ſoft; powder, pure white; ſpecific gravity 2.13; before the blowpipe becomes opake and friable, and loſes weight; ſoluble in ſulphuric, nitric, and muriatic acids. Found at Hoboken on the weſt bank of the Hudſon, oppoſite New York, in veins of ſerpentine. Theſe veins vary in breadth from a few lines to two inches, and traverſe the rock in all directions. It alſo contains ſilex and iron.

A variety analyzed by Vauquelin, yielded 2 per cent. of silex, and $2\frac{1}{4}$ of iron.

CHRYSOLITE.

The Chrysolite occurs in angular, or in somewhat rounded masses, or crystallized, usually in compressed eight sided prisms, which are variously terminated; their primitive form, according to Haüy, is a right prism with rectangular bases. The colour of the chrysolite is yellow, sometimes mixed with green or brown; it is transparent, and possesses double refraction; it scratches glass: its specific gravity is 3.4; and it consists of 50.5 per cent. of magnesia, 38 of silex, and 9.5 of oxide of iron.

It is found near Schelkowitz in Bohemia, and at Jurnau, in the Circle of Bunzlau; in serpentine, at Leatschau in Hungary; in the river St. Denis, at the foot of the volcano of the isle of Bourbon; and in the debris of the volcano of Bolsano. The chrystolite of commerce is brought from the Levant; it is in little masses which appear to be rounded by attrition; but nothing is known of its geological situation.

The *Olivin* is considered to be a variety of the chrysolite, though it differs in respect of analysis; the proportions of silex and alumine contained in it being nearly reversed, and it contains a trace of lime: its external characters agree in many respects with those of the chrysolite, but it is never found crystallized; both are by some considered to be of volcanic origin; but the correctness of this opinion, in respect to both of them, may, from their occasional geological situation, be doubted. The olivin is chiefly found in little semi-transparent masses, which, sometimes, from their being in a state of decomposition, have an irridescent and somewhat metallic lustre; it is found principally in basalts and lavas.

It occurs in basalt near the village of Colombier in the Vivarais; in the basalt of Bohemia; of Kalkberg in Russia; of Hungary; and in masses of considerable size in that of Unkel on the banks of the Rhine, near Cologne. It is also found in the same kind of rock at Teesdale in Durham; in the county of Donegal in Ireland: near Arthur's Seat, Edinburgh, and in the isle of Rum. It is found in the lavas of Etna, and of Piperino near Rome.

The semi-transparent yellowish substance enclosed in the mass of native iron found in Siberia by Professor Pallas, is generally considered to be a variety of olivin. It consists, according to Klaproth, of 41 per cent. of silex, 38.5 of magnesia, and 18.5 of iron.

SERPENTINE.*

Serpentine is always found massive; it is translucent at the edges, somewhat unctuous to the touch, and in general, yields easily to the knife. Serpentine varies exceedingly in respect of colour; which, generally speaking, is green of various shades, or bluish green, yellowish, or reddish: sometimes its colour is uniform; more often, it is spotted or veined with various colours; when thus variegated, it is considered to be less pure and of more recent formation, that when of one colour: the latter consists of 37.24 of magnesia, 32 of silex, 10.2 lime, 0.5 of alumine, 0.6 of iron, and 14 of water.

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* *Serpentine.*—Detached pieces of Serpentine, are found ſcattered through the alluvial baſis of New-York city. Some of them are beautifully coloured. The colours vary from deep green to cream coloured and whitiſh. I have pieces that preſent the appearance of vegetable forms in painting, and are in reality a kind of landſcape-ſtone.

The promontory of Hoboken conſiſts chiefly of ſerpentine is a maſſive form. It is cracked through in all directions with veins and fiſſures. Beſides the two forms of magneſia herein mentioned, thoſe veins contain asbeſtos, of a ſhining luſtre. It is greenish and cryſtallized, but the cryſtals generally croſs the vein obliquely and not at right angles.—This serpentine alſo embraces a white mineral, of conſiderable hardneſs, whoſe ſurface is frequently covered with minute cryſtals. This has been conſidered as a variety of tremolite.

Serpentine admitting a neat poliſh has been brought from Rhode-Iſland.

Some of the huge rocks of ſtellated aſbeſtos, in New-York city, run into ſerpentine. For many years ſuch a maſs has been lying in Cherry-Street near Clinton Street. Though the radiations of cryſtals are very plain, the material nevertheleſs yields eaſily to the ſaw, and can be made into ſlabs like marble. It is greeniſh and variegated with whitiſh clouds.

The more ancient serpentine is ranked among primitive rocks: it accompanies, is mixed with, or alternates with, primitive granular limestone, resting upon gneiss, or micaceous schistus, hence it has been called *Primitive* serpentine; by some *Noble* serpentine. It occurs in horizontal beds on the summit of Mont Rosa; the greatest elevation at which it has been observed. The more recent formation, sometimes called *Common* serpentine, is considered to be a transition rock; it often encloses steatite, talc, asbestus, chlorite, mica, garnet, magnetic iron, &c.; but it rarely includes metalliferous veins or beds. In the large serpentine tract of Cornwall, native copper has been found disseminated.

Serpentine occurs on the side of the Alps towards Genoa; as Zœblitz in Saxony; in Bohemia and Hungary; at Dobschau in Transylvania; at Zillerthal in the Tyrol; in the Milanese; in Piedmont, alternating with beds of magnetic iron; in Spain and France. In a word, serpentine, though less abundant than many other rocks, is met with in most mountain chains. Primitive serpentine of uncommon beauty is found at Portsoy in Scotland; that of Cornwall is considered to be of more recent formation.

It is fashioned by the lathe into vases for ornamental purposes at Zœblitz in Saxony, and at Bareuth; it is also made into chimney pieces, which are very beautiful.

Steatite and *Potstone* are considered by mineralogists to be nearly allied to serpentine.

CARBONATE OF MAGNESIA.* MAGNESITE.

Carbonate of Magnesia was heretofore considered as

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[*] The native carbonate of Magneſia has been diſcovered alſo at Hoboken, in the crevices of the ſerpentine rock, which contains the native magneſia, by Mr. J. Pierce. The ſpecimens exhibited to the Lyceum of Natu-

pure *Native* magnesia, until, by analysis, the presence of carbonic acid was detected: it has nevertheless been asserted of some varieties of this mineral, particularly that of Castellamonte, that when first brought from the quarry or mine, it contains no carbonic acid, which afterwards it absorbs from the atmosphere. It is usually found in large masses, which are sometimes cellular, and soft enough to yield to the nail, which occasionally gives a polish by passing over it; but internally, it is sometimes harder than calcareous spar: it adheres to the tongue.

The carbonate of magnesia of Roubschitz in Moravia, is found in a serpentine rock, accompanied by meerschaum. It is opake, tender, and of a yellowish grey colour, spotted with black. It consists of equal parts of magnesia and carbonic acid.

It also occurs in serpentine, in veins or beds near Piedmont: that of Baudissero, is accompanied by hydrophane, and contains 15 of silex, and 3 of sulphate of lime: that of Castellamonte consists of magnesia, carbonic acid, silex and water. Both these varieties are employed in the porcelain manufactory at Piedmont.

SULPHATE OF MAGNESIA.*

Sulphate of Magnesia occasionally occurs in the natural state, in the form of fine capillary crystals, on the surface of decomposing schistus, or of gypsum, or of the soil, and often in coal pits. It has been observed in the quicksilver mines of Idria; on the surface of gypsum in the quarries of Piedmont, and of Mont-martre near Paris; on the surface of the soil in many large tracts of Andalusia in Spain, after floods; and in the foundation and lower walls of most of the houses in Madrid, it issues in efflorescences from the mortar, arising from its decomposition, and therefore to the injury of

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ral Hiſtory, are white, powdery, and in external appearance very much like the common magneſia of the ſhops. The quantity found is ſmall, and particles of grit ſeem to be scattered through it.

* *Sulphate of Magneſia.*—From a ſample or two I have ſeen, native Epſom ſalt ſeems to be a production of ſome of the caverns in Weſtern Virginia.

the building. Similar effects are occasionally to be noticed in this country.

Sulphate of Magnesia is also an ingredient of certain saline springs. It was first discovered in the mineral water of Epsom in Surry, in 1675, from which it is extracted by boiling, and consitutes that substance which in medicine is called *Epsom Salts*. It has been since discovered in the mineral water of Sedlitz and of Egra in Bohemia. At the salt-works of Portsmouth and Lymington, it is obtained from what is termed the bittern of sea-water; which is the residue, after all the muriate of soda, or common salt, has been extracted. The mode of preparing it is not generally known.

The regular form of the crystals of this salt, is a four-sided prism, terminated at each end, by a two or four-sided pyramid: its primitive crystal is a four-sided rectangular prism. The crystals show a double refraction.

Epsom salts contain 19 parts of magnesia, 33 of sulphuric acid, and 48 of water.

BORACITE. BORATE OF MAGNESIA.

The Boracite has only been found in the mountain of Kalkberg in the Duchy of Brunswick; where it occurs in small crystals imbedded in compact of sulphate of lime. These crystals are sometimes transparent, sometimes opake, and are hard enough to give sparks with the steel. Their primitive form is the cube, which is not often found perfect; the edges and angles being mostly replaced by the planes of certain modifications to which it is subject, and which are not common to other minerals; four of the angles constantly present a greater number of faces, than the other four. The crystals become electric by the application of heat; manifesting the vitreous electricity on the angles which present the greatest number of planes, and resinous electricity on the others. The Boracite consists of about 83 parts of the boracic acid, and 17 of magnesia: when translucent or opake, it contains a proportion of carbonate of lime.

ZIRCON.[*]

Zircon, when pure, is white, rough to the touch, insipid, and insoluble in water; and is about 4 times its weight. Like the other earths, it is infusible, except by the powerful action of voltaic electricity; by the assistance of which it has been ascertained that Zircon is a compound, consisting of oxygen united with a base *Zirconium*; the nature of which is unknown. The proportions in which oxygen and zirconium enter into the composition of Zircon, have not been determined.

It is very sparingly found; and then only entering into the composition of three substances, together with silex and oxide of iron; and in one instance with a small portion of oxide of titanium: it has not been detected as a component part of any rock.

Zircon has not been put to any use.

The three minerals which are principally composed of Zircon, viz. the hyacinth, the Jargoon, and the zirconite, all occur crystallized. The form of their primitive crystal is an obtuse octohedron, but their crystals commonly have twelve planes, four of which are six-sided, and are the consequence of the replacement of the lateral solid angles of the primitive crystal, causing each of its four terminal planes to assume a rhombic form, instead of the triangular, as in the primitive crystal. The crystals of these substances, of which I possess about 45 varieties, resemble, in a remarkable degree, those of the oxide of tin, which also have for their primitive crystal a flat octohedron: they are doubly refractive, when translucent, and somewhat harder than quartz, and their specific gravity exceeds 4. These substances are infusible, but sometimes lose their colour by exposure to heat.

Zircon.—This mineral is reported to have been diſcovered among the primitive and tranſition rocks, in various places; ſuch as the vicinity of Baltimore, Trenton, Schooley's mountain, and Sharon.

HYACINTH.

The Hyacinth is of various shades of red, passing into orange red: it is transparent or translucent: its structure is lamellar, which is readily discovered in one direction.

The hyacinth, as well as the two following substances, are considered to belong to primitive countries. The hyacinth, in the form of its primitive crystal, has been found among the corundum of the East Indies; but is commonly found in the beds of rivers or of brooks. It occurs in the brook Expailly, in Auvergne in France, in a sand that is considered to be of volcanic origin; and is also met with in a sand of the same description in the territory of Vicenza, near Pisa in Italy, and in Ceylon: it is also found at Schelkowitz in Bohemia, and in Brazil. That of Ceylon consists of 70 per cent. of zircon, 25 of silex, and 0.5 of oxide of iron: that of Expailly consists of less zircon and more silex.

JARGOON.

The Jargoon occurs in small transparent or translucent crystals, which are considerably prismatic, and of a greyish, yellowish, brownish or reddish colour, having frequently a smoky tinge; and in rounded masses, as well as in crystals of considerable dimension, very nearly approaching their primitive form, and of a brown colour and opake: they seem to possess no regular structure. This substance is usually called the *Jargon of Ceylon*: it is found in the sand of rivers in the middle of that island, and has been met with in granite, near Cuffel, in Dumfrieshire in Scotland. Jargoon consists, according to Vauquelin, of 66 per cent. of zircon, 31 of silex, and 2 of oxide of iron.

ZIRCONITE.

The Zirconite is of a reddish brown colour, and nearly opake: it occurs in crystals imbedded in a rock, consisting of felspar and hornblende, at Frederick-Schwerin in Norway; by one analysis, it consists of 64 of zircon, 34 of silex, 0.25 of oxide of iron, and 1 of titanium.

The yellow and smoke coloured varieties of the above substances are called, by the Jewellers, Jargoons, and are said to sometimes passed off as diamonds, when deprived of their colour by heat: the red, or orange red, they call hyacinths: the commercial value of each is inferior to that of all the oriental gems: in Norway, the zirconite, when cut and polished, is employed as one of the habiliments of mourning.

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GLUCINE.

Glucine obtained that name from the Greek γλυκος, signifying *sweet*, on account of the sweet taste by which its salts are distinguished. When pure, glucine is a white powder, soft, and somewhat unctuous to the touch; its specific gravity is nearly 3.

Sir H. Davy has proved that glucine consists of oxygen united with a base, *Glucinum*, of which the nature is not known. It is computed that this earth is constituted of about 30 per cent. of oxygen united with 70 per cent. of glucinum.

Glucine has only been met with combined with other substances, and then only in small quantities, and in a very few minerals, viz. euclase, beryl, emerald, and gadolinite.

EUCLASE.

The Euclase is extremely rare; it has only been brought from Peru by one traveller; nothing is known of its geological situation. It has only been met with in one form, which is so complicated, that the crystals, if perfect, would have exhibited 78 planes; by cleavage, it may be reduced to a rectangular prism, which therefore is esteemed to be the form of the primitive crystal. It is of a light green colour and transparent, and readily separates into thin laminæ; but is hard enough to scratch glass, and possesses double refraction. It has not been analyzed with accuracy; by analysis of 36 grains, it yielded about 14 per cent. of glucine, 35 of silex, 18 of alumine, and 2 of oxide of iron; Vauquelin considered the greatest part of the remainder to be water of crystallization.

BERYL.* AQUAMARINE.

The Beryl is of various shades of yellow, green, and blue; its most common form is the hexahedral prism, which commonly is deeply striated longitudinally: it is double refractive in a slight degree, but only when held in particular directions. It occurs in crystals of various sizes; they have been met with a foot or more in length, and 4 inches in diameter, and nearly transparent. According to Vauquelin, the Beryl consists of 14 per cent. of glucine, 68 of silex, 15 of alumine, 2 of lime, and 1 of oxide of iron.

It belongs to primitive countries: it occurs in veins traversing granite, chiefly of the variety termed graphite: its gangue is quartz, or compact ferruginous clay.

It is found in the greatest abundance and purity near Nertchink in Daouria, on the confines of China, in compact ferruginous clay. It occurs in the Altaic chain in Siberia; and in Persia in a vein traversing a granite mountain, and is accompanied by quartz, topaz, and crystallized felspar. It has also been found in a vein passing through granite near Limoges in France; and near Autun, in a rock chiefly consisting of felspar; in graphic granite in Pennsylvania. The Beryl is also found in Brazil, Saxony, and the isle of Elba.

It occurs in Kinloch, Raimoch and Cairngorm in Aberdeenshire; at Dundrum in the county of Dublin; and at Lough Bray, and Cronebane in the county of Wicklow in Ireland.

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* *Beryl.* Our mineralogists have detected Beryl, in ſeveral different places: ſuch, among others, are Bowdoinham and Topſham, in Maine; Chesterfield, Maſſachuſetts; Haddam and other places, Connecticut; Singſing, New-York; banks of the Schuylkill, Pennſylvania; and Baltimore, in Maryland.

It is usually considered as a variety of the emerald, but differs from it both in hardness and composition, and mostly in colour.

EMERALD.*

The form in which the emerald usually occurs, is that of a six-sided prism, which also is that of its primitive crystal; it is occasionally modified at the terminations; sometimes each of the six lateral edges is replaced by a plane. Its colour is a pure and beautiful green; it is somewhat harder than quartz, but not so hard as the beryl: it never occurs in very large crystals. According to Vauquelin, it consists of 13 of glucine, 64.5 of silex, 16 of alumine, 1.6 of lime, and 3.25 of oxide of chrome; it is supposed to be coloured by the latter substance.

The emeralds known to the ancients were found in Upper Egypt, and in the mountains of Ethiopia. The finest are now found in Peru. The mine of Manta is exhausted; the present mine is situated in the valley of Tunca, in Santa-Fé, between the mountains of New Grenada and Popayan: Emeralds occur there in veins, or in cavities, in granite. They have also been found in some secondary countries; in which they are supposed not to have been in their original situation.

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* *Emeralds* occur in ſeveral parts of the Fredonian territory. They belong to the claſs of primitive rocks, in which they occaſionally reſide.—— Emeralds, reſembling in clearneſs and tranſparency thoſe of Siberia, have been found at Topſham, in well defined hexahedral priſms. They are often contained in the coarſe-grained granite; and ſometimes equal in colour the fineſt Peruvian emerald.—(*Cleaveland and Bruce.*)

Cheſterfield, in Maſſachuſetts, furniſhes them in great abundance, from the weight of an ounce and leſs, to ſix pounds. Their figure is a hexangular priſm, and their diameter ſometimes twelve inches. Colour, a light green.—(*Waterhouse.*) They are alſo found at Northampton and Goſhen.—(*Hunt.*) Haddam affords a plenty of Emeralds, ſome of which are ſeveral inches long; generally of a lightiſh green, and ſometimes of an amber colour, reſembling topaz. An extraordinary one, ſeven inches long by nine inches, of diagonal diameter, was found there.—(*Mather.*) Emeralds are ſcarce in New-York; yet the granite veins traverſing the gneiſs, have afforded a few ſmall ones. They have been alſo found at Cheſter, in Pennſylvania.

The emerald is reckoned among the gems; and when of a fine colour, and without flaws, is highly esteemed. The large emeralds spoken of by various writers, such as that in the Abbey of Richenau, of the weight of 28 pounds, and which formerly belonged to Charlemagne, are believed to be either green fluor, or prase. The most magnificent specimen of genuine emerald was presented to the church of Loretto by one of the Spanish kings; it consists of a mass of white quartz, thickly implanted with emeralds, more than an inch in diameter.

GADOLINITE. See Index.

YTTRIA.

YTTRIA, in many of its properties and appearances in its pure state, bears considerable affinity to glucine; it has the same saccharine taste, but is easily distinguished from it, inasmuch as it is nearly five times heavier than water, and by some properties discoverable only by the chemist.

It has been ascertained by Sir H. Davy, that oxygen enters into the composition of Yttria: but the base, *Yttrium*, with which it is combined, has not yet been seen in a separate form; nor have the proportions in which oxygen and yttrium respectively enter into the composition of Yttria, hitherto been decided.

In the natural state, Yttria occurs as a component part of a rare mineral substance called the gadolinite, which is brought only from Sweden, and which is so called on account of its having been first analyzed by the Swedish professor Gadolin, who named the earth Yttria, because the mineral in which it was discovered, was brought from Ytterby in Sweden.

Yttria has not been found entering into the composition of any other mineral except the Yttrotantalite.

GADOLINITE.

The Gadolinite is of a greenish or brownish black colour, and occurs massive, and crystallized, though not very determinately, in rhomboidal prisms. It is opake, slightly translucent, and hard enough to scratch glass; it generally affects the magnetic needle, and is composed of 54.75 of Yttria, with a trace of manganese, 21.25 of silex, 5.5 of glucine, 0.5 of alumine, 17.5 of oxide of iron, and 0.5 of water.

It is found adhering to felspar and mica, in veins principally composed of the former, traversed by other veins composed of the latter substance; and is accompanied by the rare mineral called Yttrotantalite, noticed in the description of the metal Tantalium. It has been found only at Ytterby in Sweden.

BARYTES.

Barytes, when pure, is white, has a sharp caustic taste, and as it possesses some of the characters of the alkalies, it has by some chemists been classed amongst them; others have denominated it an Alkaline Earth.

Barytes consists of oxygen united with a base *Barium*, with which it is united in the proportion of about 10 per cent. of oxygen to 90 per cent. of Barium. This base has the appearance of a dark grey metal, which requires considerable force to flatten it, and has a lustre inferior to that of cast iron; but it has not been obtained in quantity sufficient to allow of the examination of its physical or chemical qualities: some circumstances render it probable that Barium is four or five times heavier than water.

Barytes has never been found pure: it is combined either with the carbonic acid, forming carbonate of Barytes, or with sulphuric acid forming sulphate of Barytes. These compounds (or, to use the term given to minerals composed of earths mineralized by acids,) these earthy salts may be readily distinguished from other earthy minerals by their superior weight; being more than four times the weight of water.

Though Barytes is found, thus mineralized, in considerable quantity in certain countries, it is by no means plentifully distributed, since it has not hitherto been detected entering into the composition of any rock; nor in more than one or two earthy minerals; it is not believed to be common in soils.

Barytes is a violent and certain poison.

CARBONATE OF BARYTES. WITHERITE.

The carbonate of Barytes is of much less frequent occurence than the sulphate. It obtained the name of Witherite, from its having been discovered by Dr. Withering, who first noticed it at Anglesark in Lancashire, in a vein, with sulphuret of lead, and some of the ores of zinc, traversing a stratified mountain, composed of beds of sandstone, slate, and coal; the carbonate of Barytes is chiefly found in the lower part of the vein, the sulphate nearer the surface: the carbonate occurs in this vein in globular masses, having a radiated structure. It has since been found in cellular masses near Neuberg in Stiria, and at Schlangenberg in Siberia; it is also found in a lead mine near St. Asaph in Flintshire, and in many places in the north of England: at Alston in Cumberland; Arkendale, Welthorpe, and Dufton in Durham; Merton Fell in Westmoreland, and at Snailbach mine in Shropshire.

It is sometimes crystallized in hexahedral prisms terminated by hexahedral pyramids, and much resembles crystallized quartz. The primitive crystal is a somewhat obtuse rhomboid of 88° 6′ and 91° 54′, according to Haüy, who describes 4 varieties to which it is subject; it is generally white and translucent, sometimes yellowish, or brownish white, and easily yields to the knife.—Its specific gravity is 4.3; and it is composed of 78 of barytes and 22 of carbonic acid.

SULPHATE OF BARYTES.[*] HEAVY SPAR.

This mineral is found massive and crystallized: it occurs white and transparent or opake, and of various shades of yellow, green, red and blue. Occasionally it resembles carbonate of lime, but may readily be distinguished by its superior weight, as well as by the internal appearance of its natural joints, parallel to the sides of a right rhomboidal prism, (the form of its primitive crystal), which may mostly be seen, when held up to the light. The crystals in my possession, exhibit 111 varieties of form, which are extremly interesting; the angles of the primitive crystal, into which it may readily be broken, are, according to Haüy, 101° 32′ 13″ and 78° 27′ 47″, but when taken by means of the reflecting goniometer by clear reflections on fractured surfaces, these angles afford, 101° 42′ and 78° 18′; which I have no hesitation in believing, is their true value. It is, however, remarkable, that measurements taken by that goniometer on the natural primitive planes, however brilliant, neither agree with the measurements above quoted, nor with those of Haüy, nor with each other.

Heavy spar is harder than carbonate of lime, but not so hard as fluate of lime; it possesses a double refraction when held in a particular direction: its specific gravity is 4.7; and it is composed of 67 of barytes, and 33 of sulphuric acid.

Finely crystallized specimens are found in the mines of Hungary, Transylvania, the Hartz, Saxony, Spain, &c.; and in our own country, in those of Durham, Westmoreland, and Cumberland: and some have lately been found, though in small quantity, in the United Mines in Cornwall. It is said to occur in stalactites in Derbyshire: it occurs in opake and compact, and sometimes in concentric lamellæ, or in fine concentric fibres, in the same county, and is there termed *Cawk*.

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[*] *Sulphate of Barytes* received from the Louiſiana lead mines; from the head waters of James River; from Monocaſy, near Fredericktown Maryland; from Newtown, in Suſſex county, New-Jerſey; and from ſeveral other places.

A variety has been found in the mines of Saxony and of Derbyshire, in small white rhomboidal prisms, laterally aggregated in columns, which have a pearly lustre and are generally translucent. It is called *columnar* heavy spar, or *stangenspath*; it is sometimes mistaken for carbonate of lead.

Sulphate of Barytes is also met with of a *granular* texture, somewhat resembling that of statuary marble, from which it is at once distinguished by its greater weight: it is composed of 90 per cent. of sulphate of Barytes, and 10 of silex. It is found at Pegau in Stiria, with sulphuret of lead; at Freyberg in Saxony; at Schlangenberg in Siberia, with malachite and native copper.

Another variety which occurs near Bologna in Italy, thence termed the *Bolognian Stone*, in translucent pieces of a smoke grey colour, gives out, when rubbed, a fetid smell; which by some has been attributed to the presence of bitumen.

The sulphate of Barytes is never found forming mountains, rarely in beds; but it alternates in thin beds with spathose iron at Poratsch in Hungary. Nor is it often found in large masses: but it often occurs in considerable veins, rich in metalliferous ores, in primitive, transition, and flœtz mountains. It accompanies sulphuret of antimony in the mines of Hungary, and sulphuret of mercury in those of the Palatinate; sometimes also zinc, iron, lead, and sulphuret of copper.

The uses of sulphate of Barytes are very limited; it is sometimes used in metallurgy, to facilitate the fusion of certain metalliferous gangues. It is said that the variety called Cawk is used in the smelting of copper at Birmingham.

HEPATITE.

This mineral occurs in lamellar or globular masses, of a yellowish, brownish, or blackish colour, which give out a fetid odour on being rubbed or heated; it consists of 85.2 of sulphate of Barytes, 6 of sulphate of lime: 1 of alumine, 5 of oxide of iron, and 0.5 of carbon.

It has been met with at Andrarum, and in the silver mine of Kongsberg in Norway; at Lublin in Galicia; and at Buxton in Derbyshire.

STRONTIAN.

Strontian, when pure, is white, and possesses a caustic taste: it has a strong affinity to the alkalies.

It consists of oxygen united with a base, *Strontium*, which much resembles Barium, being of a dark grey colour, and having much the appearance of a metal, but has not much lustre.

Strontian has never been found pure; but only combined with the carbonic or sulphuric acid, forming sulphate or carbonate of Strontian: and it has only been detected in one or two instances, entering into the composition of earthy substances, and then only in very small proportions; and as it has not been found as a component part of any rock, it may be said to be a rare earth.

CARBONATE OF STRONTIAN. STRONTIANITE.

It is of a greenish or yellowish white, or of a green colour, and is somewhat harder than carbonate of Barytes; it occurs in radiated masses, the cavities of which are sometimes lined with acicular crystals: among which, regular hexahedral prisms have sometimes been observed.

Its specific gravity is 3.67; it consists of 69.5 of strontian, 30 of carbonic acid, and 0.5 of water. Occasionally, it very much resembles carbonate of barytes, but it is not quite so heavy, and is somewhat harder.

It was first discovered at Strontian in Scotland, whence its name, in a vein passing through gneiss, and accompanied by galena, heavy spar, calcareous spar, and iron pyrites: it has since been found in the lead hills; and Humbodt discovered in Peru, a variety which is white, translucent, and radiated.

SULPHATE OF STRONTIAN.* CELESTINE.

This mineral is whitish or of a delicate blue; whence it obtained the name of Celestine: it occurs in opake masses, or fibrous, or, more rarely, crystallized; the primitive form, according to Haüy, is a right prism of 104° 28′ and 75° 12′, with rhomboidal bases; he has noticed 8 varieties in the form of its crystals. It is not so heavy as carbonate of Barytes, its specific gravity being only somewhat above 3; and it is not quite so hard as fluor: it possesses double refraction. It consists, according to Vauquelin, of 54 per cent. of strontian, and 46 of sulphuric acid.

In opake spheroidal masses, it is found at Montmartre near Paris, disseminated in beds of argillaceous marl, separating beds of sulphate of lime. This variety contains 8 per cent. of carbonate of lime, and somewhat less than 1 per cent. of iron. The fibrous variety of a blue colour, is found in a plastic clay, at Beuvron, near Toul, in the department of la Meurthe in France; at Frankfort in Pennsylvania, of a sky blue colour: and in Egypt. The spheroidal masses above mentioned, as well as specimens from Strontian in Scotland, occasionally present minute crystals. The best crystallized specimens are said to be found at Noto and Mezzara in Sicily, in beds of sulphur, alternating with beds of sulphate of lime: it also occurs in beds of sulphur in Spain; in sulphate of lime, in the department of la Meurthe in France; and in beds of ferruginous marl near Bristol, sometimes finely crystallized.

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* *Sulphate of Strontian.* The fibrous variety has been diſcovered ſome where weſt of Albany,—(*Low.*)—and in one or two other places.

ALKALINE MINERALS.

Including such as chiefly consist of an Alkali united with an Acid.

POTASH.*

It has already been remarked, in noticing the alkalies generally, that potash is not a simple body; that it consists of oxygen united with a base (*Potassium,*) which bears a strong affinity, in certain respects, to the metals; and that it much resembles quicksilver, but is lighter than water.

Potash is constituted of about 17 per cent. of oxygen, united with about 80 per cent. of potassium.

It is found in the mineral kingdom, entering into combination in at least 15 earthy compounds; amongst which are felspar and mica, two principal ingredients of

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[*] *Potash.* The preparation of Potaſh in New-York, by burning wood and letching the aſhes, has furniſhed a body of inſtructive facts. I here ſtate the reſult of much careful inquiry:

A buſhel of wood-aſhes uſually weighs about 60 lbs. and it requires 500 buſhels of aſhes, or $500 \times 60 = 30000$ lbs. to make a ton, or 2000 lbs. of marketable potaſh. Thus, no more than 1-15th of the aſhes is vegetable alkaline ſalt. Of courſe, a bushel of aſhes affords 4lbs of alkali.

A cord of wood weighs about 3000 lbs. and ſo little ſolid matter is left after burning, that ſuch a pile of wood will not yield more than 100 lbs. of aſhes, or 6¾ lbs. of alkali. So much of the matter of wood is converted to gas, or eſcapes in vapour by the action of fire, that only 1-30th remains behind in the form of aſhes.

By this calculation it appears that 1-450th part of the weight of wood, before incineration, is potaſh; and it follows that 300 cords of wood, or wood to the weight of 900000 lbs. muſt be burned to make a ton of potaſh.

All kinds of wood are not capable of affording this amount of potash.—There are ſome ſorts, ſuch as cedar, pine, and generally the wood of trees abounding in gum or reſin, which afford little or none of this alkali: But birch, maple, baſſwood, oak and hickory, yield potaſh of the beſt quality, and in the greatest quantity.

the oldest of the primitive rocks; it likewise occurs in others combined with soda; therefore the term vegetable alkali, as applied to potash, is not correct, although it is procured in the greatest abundance from the combustion of vegetable matter of various kinds.

Potash is likewise found combined with the carbonic and nitric acids.

CARBONATE OF POTASH.

Carbonate of potash, in its various states of preparation from different kinds of vegetable matter, is also called familiarly, potash, pearlash, or salt of tartar.

The combustion of vegetable stems, leaves ashes consisting of the earthy and metallic ingredients of vegetables, and a proportion of the carbonate of potash. The latter is dissolved out by water, and being dried, is the *potash* of commerce. This when calcined, is called *pearlash*. In England and Ireland, potash is obtained from the combustion, principally, of the common fern; 1000 parts of which, afford about 37 of ashes, and four and a quarter of potash. In the mountainous forests of Germany, and woodland tracts of Poland and Russia, it is prepared in considerable quantity. The British market is chiefly supplied from North America, where the employment of making potash is subsidiary to clearing the ground for agriculture. The *tartar* that is deposited on the sides of the casks in wine countries is, when soft, formed into masses, which being dried in the sun, are afterwards piled upon a furnace with alternate strata of charcoal: the acid and inflammable matter of the tartar is then burned off, without fusing the alkaline part, which becomes very porous and perfectly white: it is then dissolved in hot water, and being afterwards evaporated, dried, and slightly calcined, becomes fit for sale, and is the *salt of tartar* used in medicine. It consists of 48 parts of potash, 43 of carbonic acid, and 9 of water.

It has long been a question among chemists, whether the potash obtained by the combustion of vegetables is formed by this process, or whether it previously existed in the plant. Some of the older eminent chemists were of the former opinion, but the latter is now gaining ground.

NITRATE OF POTASH.*

Nitrate of potash, *Nitre*, or *Saltpetre*, is naturally found only in an efflorescent state, in extremely delicate fibres, and is very abundant. There are few countries in which it is not found; it mostly occurs on the surface of the earth; never far beneath it. Old walls, affording animal or vegetable matter in a state of decomposition, dry chalky plains, or sands containing carbonated lime, are frequently covered by it. Argillaceous earths, or pure sand, never contain it; whence it seems probable that lime is essential to its composition, and that during its spotaneous formation, it absorbs at least one of its principles from the atmosphere.

Nitre is occasionally, though rarely, found in water; but it enters into the composition of several plants, as of tobacco, the sunflower, hemlock, &c. It consists of 49 parts of potash, 33 of nitric acid, and 18 of water.

It is found on many of the plains of Spain; and on the chalk near Evreux in France, from which it is gathered 7 or 8 times every year; and in the deep grottos of Mont Homburg, in Germany. In Italy it is afforded

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Nitrate of Potaſh. A native earth is ſaid to exiſt on one of the Southern branches of the river Potomac, in Maryland, bordering on Virginia, from which Saltpetre is manufactured. The material was ruſty or reddiſh brown, and ſoft enough to be ſcraped by the finger-nail. The baſe ſeemed to be a bolar or argillaceous earth. On powdering ſome of it, and adding ſulphuric acid, I was ſaluted by the fumes of the nitrous acid.—(*Law*, *in Med. Repos. Vol.* 12, *p.* 296.

Native ſalt-petre exiſts in Kentucky aſſociated with particles of quartz and ſand-rock. Of this, it is reported there are extenſive ſtrata, horizontally diſpoſed. In the ſpecimens I have ſeen, the ſalt petre ſeemed to be diſtributed through the whole rocky maſs, to cement the ſilicious particles together, and to aſſiſt their coherence. Though in ſome parts, the ſaltpetre filled up fiſſures between the parallel layers of the ſand-rock, and occupied in like manner veins and cracks acroſs the ſtrata.

The ſalt-petre caves of Virginia and Kentucky have been mentioned already. The eſtimate of their product is highly conſoling to our country. Their hiſtory as well as that of the ſaltpetrous ſand rocks afford curious problems for chemiſts to ſolve.—(*Brown*, 6 *Trans. Am. Philos. Soc.* 13 *Med. Repos. p.* 367.

Thus Potaſh is a mineral as well as a vegetable alkali.

by the calcareous soil of Molfetta. Hungary, the Ukraine, and Podolia, furnish Europe with abundance of nitre. In Arabia it occurs in a valley between Mount Sinai and Suez. Persia affords it, and it is very common in India, especially in a large plain about 60 miles from Agra in Bengal, which is said to have been formerly well peopled. It is found at the Cape of Good Hope. The Mountainous regions of Kentucky, which are calcareous and full of caverns, afford it to the inhabitants of North America. In South America, the plains bordering the sea, near Lima, are covered with it.

But nitre is not naturally produced in sufficient quantity for its multiplied uses. It is therefore procured artificially. In order to this, heaps of Rubbish, of plaster and of earth, with dung and other vegetable matter, are placed under sheds; these are moistened with various animal fluids, as blood, &c. and the mass is then exposed to rot in the air. The consequence seems to be, that the azote disengaged by the putrefaction of the animal matter, combines with the oxygen of the atmosphere, producing nitric acid; which, by uniting with the potash of the vegetable matter, forms nitre. This is afterwards purified.

Nitre is employed in medicine, the arts, and in metallurgy, for assisting the processes of oxidating and smelting; but its principal if not its chief use is in the manufacture of gunpowder, for which that imported from Egypt is the most esteemed, as it contains least calcareous matter. Gunpowder consists of 76 parts of nitre, 9 of sulphur, and 15 of light charcoal.

SODA.

Soda is not a simple, elementary body, but a compound, consisting of oxygen united with a base *(Sodium)*, which possesses several characters common to the metals; it most resembles silver, but is lighter than water. Soda consists of about 22½ of oxygen, and 77½ of sodium.

Soda is no where found in the pure state; it enters into combination in about 12 earthy minerals already described, in proportions varying from 1 to 35 per cent.; and is met with in 5 others combined with potash.

Soda is found both in the mineral and vegetable kingdoms; it occurs combined with the carbonic, sulphuric, boracic, and muriatic acids; forming carbonate, sulphate, borate, and muriate of soda.

CARBONATE OF SODA.*

Carbonate of soda is both mineral and vegetable. When mineral, it is met with either dissolved in the water of certain hot springs, as those of Carlsbad in Bohemia, and Rykum in Iceland, or in certain lakes, as in Egypt and Hungary; or in the state of a solid salt found beneath the surface of the soil:—when vegetable, it has been found to exist ready formed in the plant called Salsola Soda, and in certain sea weeds. It is procured from both these sources. Pure carbonate of soda by analysis yields 22 of soda, 15 of carbonic acid, 62 of water.

Carbonate of soda is found in the natural state nearly compact, but somewhat striated, between Tripoli and Fezzan in Africa; and according to Dr. D. Munro, in a stratum only one inch thick, in contact, both above and below, with muriate of soda (common salt). It is collected to the amount of hundreds of tons annually. It is called *Trona*. It rarely reaches Europe. Trona consists of 37 soda, 38 carbonic acid, 22½ water, 2½ sulphate of soda.

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* Several species of maritime plants, particularly of Salsola or Glasswort, on being reduced to ashes by fire, afford a Kelp, or mass of ashes replete with Soda.

This same alkali has also been prepared by the burning of certain marine vegetables, such as the fuci and ulvæ that grow upon the rocks under Salt water.

A sample of salt, brought to me from a well in one of the Saline districts of Kentucky, was a mixture of Carbonate of Soda with muriate of Soda; of which the quantity of the former was so considerable as to render it unfit for seasoning and curing provisions. The water from which these Salts were extracted may be compared to the Nitrian pools of Egypt.

Soda therefore, like potash, is both a vegetable and a mineral alkali.

The mineral carbonate of soda called *Natron*, is procured from the lakes of Egypt and Hungary. The former are six in number, situated in a barren valley, called Bahr-bela-ma, about 33 miles westward of the Delta. The soil consists of calcareous rock, mixed with gypsum and covered with sand. These lakes contain both the muriate and carbonate of soda, and the edges of the lakes are surrounded by a band some yards in breadth, of these substances, chiefly of the latter; but the principal accumulation is at a little distance from the bank. It is taken out and exported in that impure state.

The lakes of Hungary are four in number, and lie between Dobritzin and Groswaradin; they are much neglected. The soil is a stiff blue clay covered by white calcareous sand. The lakes are from one to two miles in circumference, and in the winter are full of water: about April they are generally dry, and the saline efflorescences of natron, mixed with a little sulphate of soda, appear; which, being gathered, re-appear in three or four days; this kind of harvest continues till towards the end of October, when winter begins, and the lakes become full of water. The Natron, both of Egypt and Hungary, is imported in pulverulent masses of a dirty grey colour.

The Natron of Egypt yields by analysis about 32 of carbonate of soda, 21 of sulphate of soda, 15 of muriate of soda, and 32 of water. That of Hungary is composed of the same salts, but varies in respect of their proportions.

Vegetable carbonate of soda is of two kinds, *Barilla* and *Kelp*. The former is the residuum left after the combustion of the plants, salsola soda, salicornia, &c. which are cultivated by the Spaniards on the coast of the Mediterranean. The sea water is occasionally admitted to these plantations. When the seed is ripe the plant is cut down, the seed rubbed out, and the plant is burnt in a furnace. *Kelp* is made from sea weeds, principally from the leafy fuci, vesiculosus and serratus, which grow on rocks between high and low water marks. These plants are gathered on the shores of Britain and other countries from May to August, and after being dried, are burnt in pits; during combustion the mass becomes fluid, and when cold is broken into large pieces, for sale. It is very impure: the proportion of pure soda contained in the mass, varies from one and a half, to 5 per cent.

SULPHATE OF SODA.[*]

Sulphate of Soda is found in an efflorescent state, of a yellowish or greyish white colour, or in an earthy form, or more commonly dissolved in certain mineral waters: it is of a bitter saline taste, and is most commonly met with in the neighbourhood of rock-salt or brine springs. It consists of 27 of sulphuric acid, 15 of soda, and 58 of water.

Sulphate of Soda is found in many of the lakes of Austria, Lower Hungary, Siberia, and Russia, and in Switzerland; near Madrid in Spain it occurs in efflorescences at the bottom of a ravine, and it is said to form an ingredient of the waters of the Tagus. It has been found in the workings of old mines near Grenoble in France, and sometimes on old walls in the same manner as nitre. It is also found in the ashes of some vegetables, especially of sea-weeds, of the tamarind, and of some kinds of turf; and is therefore not an uncommon substance. When purified of the iron with which it is usually tinged in the native state, or when prepared artificially, it is used in medicine under the name of *Glauber's Salt.*

BORATE OF SODA.

Borate of Soda, or Borax, is chiefly, if not only, brought from Thibet, where it is procured from a lake which is entirely supplied by springs, and is fifteen days journey from Tisoolumbo the capital. The water contains both borax and common salt, and being in a very high situation, is frozen the greater part of the year—

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[*] Sulphate of Soda has been found native in some of the Limestone Caverns. Alſo, in the preparation of ſea-ſalt from ocean-water: (this article has been procured in large quantity.) Glauber's ſalt therefore is an ingredient in the liquid of the ſea.

The edges and shallows of the lake are covered with a stratum of borax, which is dug up in considerable masses, and the holes thus made are gradually filled by a fresh deposition: from the deeper parts of the lake, common salt is procured. The borax in its rough state is called *Tincal*, and is brought to Europe in the form of a brownish grey impure salt; or in detached crystals about an inch in length, of a pale greenish hue, and in the form of compressed hexahedral prisms.

But it is said also to be found in the island of Ceylon, in Tartary, in Transylvania, and in Lower Saxony, and abundantly in the province of Potosi in Peru.

The purification of Borax is an art confined only to a few chemists: when pure it consists of 34 parts of boracic-acid, 17 of soda, and 47 of water.

MURIATE OF SODA.* ROCK SALT. COMMON SALT.

Rock Salt is found in beds or masses; sometimes crystallized in the form of the cube, which is that of its primitive crystal, and into which pure Rock Salt may readily be cleaved; when impure, as when its brown co-

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* Common ſalt has been prepared from sea-water in various places, very pure, elegantly crystallized and of great purity. The water is ſeparated by ſpontaneous evaporation, and the salt left behind to concrete in shallow pans.

The ſalt ſprings in the internal parts of the Frediſh ſtates and territories, are numerous and in ſeveral places very rich in muriate of ſoda.

In New York, thoſe of Salina, Montezuma, and Galen, are among the moſt diſtinguiſhed, and afford inexhauſtible quantities of excellent Salt. The Onondaga Lake, which receives the water of the Salina-Springs, has on that account, been ſometimes called the ſalt-lake, (*See Dewitt in the Trans. of the Society for the promotion of arts, and Med. Repos. Vol.* 2.) In Indiana, there are ſalt ſprings of great importance, to the inhabitants near the Wabaſh. (*Acts of Congress.*)

In Virginia, Preſton's ſalt-wells afford a ſupply for the adjacent region, and appear to be inexhauſtible.

In Kentucky the ſalt-ſprings and ſalt-licks, are a very remarkable feature in that curious and intereſting ſection of our country.

In Upper Louiſiana the ſalines or ſalt prairies, or ſalt plains near the northern ſources of the Arkanſa excite the attention of all viſitors and travellers The ſoil in many parts of the extenſive tracts ſituated between the Miſſouri and the Arkanſa, is ſaid to be ſo highly impregnated with ſalt, that freſh water to drink is a rarity.

It may be rationally preſumed that theſe ſprings and others not herein enumerated, are fed by ſtrata or depoſits of rock-ſalt, forming ſtrata below. Water running over ſuch thick and ſolid maſſes of ſalt, carries away a lour is derived from an intermixture of clay, its structure is less determinately lamellar; its lustre is shining or vitreous; it is either translucent or transparent, and its colour is very various, as white, grey, reddish brown, brick red, violet, blue, and green. It yields easily to the knife; its specific gravity is 2.54; pure muriate of soda, according to Berzelius, is composed of 46.55 of muriatic acid, and 53.44 of soda. Rock Salt, according to Kirwan, is composed of 33 of muriatic acid, 50 of soda, and 17 of water: when of any of the forementioned colours, it is always somewhat impure. It is sometimes, though not often, of a fibrous texture.

Muriate of Soda is one of the most abundant substances in nature; not only is it found in large beds and masses, but also in the waters of certain springs and lakes; and in those of every sea. It forms about one-thirtieth part of the waters of the Ocean.

Salt, or *Brine Springs* are not found in primitive countries; but generally arise from the newer secondary: nevertheless they are said never to be far distant from the chains of primitive mountains: they are found at the foot of the Alps, the Vosges, the Pyrenees, the Carpathian mountains, &c.; those of Droitwich, in our own country, are surrounded by a brownish red sandstone, which is considered to be the old red sandstone of Werner. So immense is the quantity which rises from the four pits, which are sunk through various kinds of soil, rock, and gypsum, that, although that which is used bears but a small proportion to that which runs to waste, the quantity of salt annually made from them amounts to about 16,000 tons. Salt springs are said to arise in countries in which no deposition of Rock salt has been discovered; the brine commonly contains some portions of certain other salts, as sulphate of soda, and

part of it. When the brine runs away, there is ſaid to be a ſalt-ſpring; when it is ſtagnant and reached only by digging, it conſtitutes a ſalt-well. The ſuppoſed beds of rock-ſalt ſupplying the ſprings and wells, were probably derelictions of the ſalt ocean which originally covered the whole of North America, or of the ſalt lakes that continued to cover extenſive tracts of that continent, after the primitive ocean had retired. The reaſons for this opinion may be ſeen in my memoir on the organic remains which were depoſited during thoſe periods, and that have come to view ſince the waters retired to their preſent reſervoirs.

sulphate of lime, &c. and it has been remarked in regard to some springs, that the quantity of brine always increases after heavy rains.

Rock Salt is commonly disposed in thick beds; either superficial, as in Africa, or of a very great depth, as in Poland: sometimes they are very high above the level of the sea, as in the Cordilleras of America, and also in Savoy; where they are found at an elevation equal to that of perpetual snow. In Spain, Rock salt occurs in vast masses, which seem to be isolated.

Sulphate of lime, or gypsum, almost always accompanies Rock salt; and is sometimes so impregnated by it, as to be worked as a Salt mine, as at Arbonne in Savoy.

Red or greyish clay frequently alternates in beds with Rock salt; but blocks or masses of clay are said more often to be enclosed in it: when in beds the clay is accompanied by sand, grit-stone, and rounded pebbles, and by compact carbonate of lime, which is sometimes fetid, sometimes bituminous. Rock salt commonly rests upon sulphate of lime, and is covered by carbonate of lime. In the beds of various substances which accompany it, are sometimes found the remains of organized bodies, the bones of elephants and other mammalia, carbonized wood, fossil-shells, and bitumen; and frequently masses of sulphur are found in the sulphate or carbonate of lime.

Several countries in Europe abound in Rock salt and Salt springs; Spain, Germany, Italy, part of Russia, &c.; in England in Worcestershire and Cheshire; in France there are many Salt springs, but no known deposite of salt. Sweden and Norway are without salt. It is abundantly found in many countries of Asia, Africa, and America.

AMMONIA.

Ammonia, or *Volatile Alkali*, when pure, subsists in a gaseous form. It is commonly believed to consist of hydrogen and nitrogen; but some experiments of Sir H. Davy have induced the suspicion that it contains 7 or 8 per cent. of oxygen.

It is only found combined with the sulphuric and muriatic acids; forming sulphate and muriate of ammonia.

SULPHATE OF AMMONIA.

Sulphate of Ammonia has an acrid, bitter taste. It occurs in the form of stalactites, of a yellowish colour, and covered by a whitish, farina-like dust, which are found in the fissures of the earth surrounding certain small lakes near Sienna in Tuscany. It consists of 40 per cent. of ammonia, 42 of sulphuric acid, and 18 of water.

MURIATE OF AMMONIA. SAL AMMONIAC.

The Muriate of Ammonia is not abundant; it chiefly appears in efflorescence of a greyish white, yellowish, apple green, or brownish black colour; but sometimes occurs in small crystals which are not very determinate. It consists of 40 per cent. of ammonia, 52 of muriatic acid, and 8 of water

This salt is characterized by its insolubility in water, and by the ammoniacal odour which it gives out when triturated with lime, better than by any of its external characters. It sometimes exists in the substances which enclose it, in such a manner, as to be without the reach of the eye or the feel.

It is principally found in the neighbourhood of volcanoes, sublimed in the cracks of lava, among other volatile matters near their craters. It thus occurs in the lavas of Etna and Vesuvius. At Solfatara it escapes in bubbles, which are caught and condensed in long earthen pipes. It is said to appear in efflorescences on certain rocks in Turquestan in Persia, in Calmuc Tartary, Bucharia and Siberia; in some lakes of Tuscany, and certain Springs of Germany; and in some English coal, especially that of Newcastle.

Volatile alkali is obtained from Muriate of Ammonia. The Sal Ammoniac of commerce is chiefly brought from Egypt, where the soot proceeding from the combustion of the excrements of certain ruminating animals who feed on saline plants, is collected in chimnies, whence the soot is taken and placed in large glass vessels: it is then heated sufficiently to drive off the muriate of ammonia, which is sublimed, and attaches itself to the upper edges of the vessel in cakes, which are always, in some degree, tinged by the soot; in this state it is sometimes preferred for use in the arts. The soot affords nearly one third its weight of Sal ammoniac.

It is obtained in various parts of Europe by the distillation of animal matter.

It is used in medicine, and in the arts.

NATIVE METALS

AND

METALLIFEROUS MINERALS:

Including such Metals as occur nearly pure, or combined with oxygen, or sulphur, or one or more of the acids; together with those compound substances commonly denominated Metalliferous ores.

IRON.*

Pure Iron is of a bluish grey colour, and has a granular texture; it is hard, ductile, and malleable, and is the most tenacious of metals next to gold. Like cobalt and nickel, it is magnetic; and so readily is polarity acquired by iron, that a bar remaining a long time in a vertical position, or even approaching to it, becomes magnetic. The northern pole is always at the lower extremity. The specific gravity of iron is about 7.

Iron is an ingredient of mica, which enters largely into the composition of some of the oldest and most abundant primitive rocks; and being found in all soils, and in almost every rock, it is therefore considered to be the most generally diffused substance in nature. It has been met with in the nearly pure metallic state in considerable masses, reputed to have fallen from the atmosphere; but these masses are generally alloyed by

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Iron.—Iron is found abundantly in the United States; in the veins of the primitive and tranſition rocks of New-York and New-Jerſey; and in ſecondary and alluvial tracts of both theſe States, and of ſeveral others.

nickel. Native Iron is also said to have been found disseminated in certain metalliferous veins. The ores of iron are very numerous; it occurs combined with sulphur, oxygen, the oxides of titanium, manganese, and chrome; the phosphoric, sulphuric, carbonic, and arsenic acids; with silex, alumine, lime, and with water. Mineralogists are not well agreed either in respect of the names or the arrangement of the ores of Iron.

The ores of Iron, which are of a dark brown or black colour, and in which the iron is considered to be combined with a small proportion of oxygen, such as the magnetic and brown iron ores, belong chiefly, though not exclusively, to primitive countries: they *often form* an integral part of primitive rocks.

The Red Iron ores chiefly belong to secondary and alluvial countries; they are occasionally met with in the veins of primitive mountains, but are not found entering into the composition of primitive rocks.

The red and argillaceous varieties, but particularly the latter, it is remarkable, are generally found in the neighbourhood of coal, so essential to their reduction to the metallic state; either resting on the coal or filling up the fissures in it. Iron ore is thus found in the collieries of Glamorgan, of Monmouth, Staffordshire, Shropshire, and of those of Carron in Scotland.

It would be vain to attempt the enumeration of the uses to which iron is put by man. Steel is an artificial combination of iron with carbon. The brown colour used in Porcelain painting is oxide of iron.

An ore, in which iron is combined with alumine, is used in the making of what are termed *red lead* pencils. Plumbago, or *black lead*, is a natural compound of iron, with a large proportion of carbon.

NATIVE IRON.

Native Iron is said to have been found in veins.

Scrieber mentions having met with it in the form of a ramose stalactite covered by brown fibrous oxide of iron, mingled with quartz and clay, in a vein traversing the mountain of gneiss, called Oulle, near Grenoble in France.

Bergman cites instances of malleable iron having been found in a gangue of brown garnets, near Steinbaoh in Saxony.

Lehman says that it was found in a vein at Eibestock in Saxony.

Karsten describes a brown oxide of iron mingled with spathose iron and sulphate of barytes, which contained native iron disseminated through the mass. It was found at Kamsdorf; and consisted of about 92½ parts of iron, 6 of lead, and 1½ of copper.

NATIVE METEORIC IRON.*

Native Meteoric Iron is somewhat paler and lighter than common metallic iron, and is often more malleable: it is supposed that its colour and superior malleability may be owing to a small portion of nickel combined with it, and that its lightness is owing to the very numerous minute cells observable in it. It is magnetic, flexible, and cellular; the cells are occasionally filled by a yellowish and translucent substance, of a somewhat resinous appearance, by some considered as a variety of olivin.

Meteoric Iron has been found in different quarters of the globe; in Bohemia, in Senegal, in South America, and in Siberia; of the latter we have the best account. It was found by professor Pallas on the top of a mountain, on which there was a considerable bed of magnetic iron-stone, on the banks of the river Jenisei. It weighed

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* *Native Meteoric Iron.*—In the New-York Inſtitution Col. Gibbs has placed a maſs of native iron, brought from one of the weſtern branches of the Red River, in Louiſiana. It weighs 3000 lbs. Its greateſt length exceeds three feet, and its greateſt breadth amounts to about two and a half feet. Its exterior ſurface is irregular, abounding in elevations and depreſſions.—(*Med. Repos. vol.* 15, *p.* 88, *and vol.* 16, *p.* 424.) Pieces have been liberally beſtowed on curious individuals and muſeums. It is perfectly malleable, and ſeveral articles hammered out of pieces directly from the maſs, are in my poſſeſſion. Its outſide is covered with a blackiſh cruſt, on the removal of which the bright metal ſoon becomes oxyded again. It appears to be remarkably pure, containing neither nickel nor any other metal.—(*Amer. Min. Jour. p.* 124.)

The meteoric ſtones, which fell at Weſton, in Connecticut, contained iron, the greater part of which was in a perfectly metallic ſtate. A whole ſtone attracts the magnet, and its powder is attracted by the magnet. Portions of metallic iron may be ſeparated, large enough to be extended under the hammer. Some of the iron is combined with ſulphur into pyrites. *(Silliman and Kingsley.)*

1680 Russian pounds, and possessed some of the important characters of pure iron, as malleability and flexibility, and was reported by the inhabitants to have fallen from the sky. The mass found in the Vice-royalty of Peru in South America, was described by Don Rubin de Celis: it weighed about fifteen tons; it was compact externally, and was marked with impressions as if of hands and feet, but much larger, and of the claws of birds; internally it presented many cavities: it was nearly imbedded in white clay, and the country round it was quite flat and destitute of water. Meteoric Iron is alloyed by about 3 parts in the 100 of nickel; which, it is worthy of remark, is also found by analysis to be a *constituent* part of all those stones, which in various parts of the European Continent, in England, and in America, have been known to fall from the atmosphere, and are therefore termed *meteoric stones*.

In the imperial cabinet at Vienna there is a very considerable mass of meteoric iron, which fell from the atmosphere in 1751 at Hraschina, near Agram in Croatia, appearing in the air like a globe of fire. It consists of 96½ per cent. of iron and 3½ of nickel.

The Abbé Haüy is of opinion that some appearances of crystallization approaching the regular octohedron may be traced in meteoric iron.

IRON PYRITES.[*] SULPHURET OF IRON.

Iron Pyrites is tin-white, steel-grey, or of various shades of yellow, and is found in mass, and of various shapes, as stalactitic, nodular, &c. and crystallized. It includes several varieties. some of which greatly resemble yellow copper ore, but may be readily distinguished, as the latter yields to the knife, which iron pyrites does not.

[*] *Iron Pyrites.*—This mineral exiſts in primitive and ſecondary rocks abundantly in New-York, New-Jerſey and elſewhere, and is frequent in alluvial ſituations. It exiſts in cubes, parallellopipeds, rounded balls, irregular globules, and in maſſive forms. Its colours are bright yellow, pale yellow, and brown. Some of its forms are permanent; in other caſes, it decompoſes ſpontaneouſly, and crumbles down.

Pyrites often penetrates wood that has been buried long in the earth and carbonated. Such kinds of mineralized timber have been dug up on Long-Iſland, Staten-Iſland, Waſhington city, and innumerable other places.

One variety, which affects the magnetic needle, is therefore called *Magnetic Pyrites.* It is not found crystallized; it is generally of a bronze yellow, but is sometimes brown. Its magnetic property is supposed to be derived from its containing a larger proportion of iron than common pyrites; it consists of 63.5 metallic iron, and 36.5 of sulphur; and its specific gravity is 4.5.

It is believed to belong almost exclusively to primitive countries. It is met with in Saxony, Bohemia, Silesia; at Moel Elion in Caernarvonshire, it occurs with common pyrites in a kind of serpentine, and near Nantes in France in limestone.

When nearly of a tin-white, yellowish, or steel-grey, it is termed *White Pyrites.* The principal difference between it and *Common Pyrites* seems to be, that the former decomposes much easier. The specific gravity of the former is 4.7; of the latter 4.8. Both are found crystallized in the cube, which is considered to be the form of the primitive crystal: the crystals of common pyrites, in my possession, afford 38 varieties of form, which are very beautiful and interesting. White and common pyrites differ very little in the results of their analyses. The latter yields about 47½ parts of iron, and 51½ of sulphur. The former contains a rather larger proportion of sulphur.

A variety is occasionally found containing both sulphur and arsenic; it is of a paler colour than common pyrites. The arsenical ore of iron called *Mispickel* is noticed under the head Arsenic, to which it properly belongs.

Iron Pyrites occurs in almost every species of rock.—It abounds in granite, and particularly in argillaceous schistus. It is never wrought as an ore of iron, but is largely employed in the manufacture of green vitriol; and sulphur is often procured from it by sublimation.

MAGNETIC IRON ORE.*

Magnetic Iron Ore is generally of an iron-black colour, with a slight metallic lustre. It is found massive, and crystallized in some varieties of the octohedron, which is considered to be its primitive crystal. It is sufficiently magnetic to take up iron filings, and possesses polarity. It is nearly a pure oxide of iron. Its specific gravity is about 4.5.

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* *Magnetic Iron Ore.* The Magnet is found abundantly in the highlands of New-York, near the Military Academy at Weſt-Point, in the primitive formation of rocks. It is alſo ſo plentiful in the tranſition rocks

It is most commonly found in primitive countries, generally in beds and large masses; and is accompanied by hornblende, granular limestone, and garnet; and occasionally by blende, all the varieties of pyrites, fluate of lime, oxide of tin, and sulphuret of lead, &c.

The mountains called Taberg in Swedish Lapland, and Pumachanche in Chili, are said to consist almost entirely of Magnetic Iron Ore. It is plentifully found also in Corsica, Saxony, Bohemia, Silesia, Russia, and the East Indies. In Great Britain, in Cornwall, Devon, and the Isle of Unst in the Hebrides.

It exists in great abundance and purity at Roslagia in Sweden, where it is manufactured into the best bar iron, so much sought after by our manufacturers of steel, though it affords only middling cast iron.

Some varieties of Magnetic Iron ore, either compact, sandy, or earthy, have been found, containing from 12 to 22 per cent. of oxide of titanium. The sandy variety is found in angular or rounded masses, and in octohedral crystals. It occurs at Hunstanton, in Norfolk; in Agyleshire; and at Arklow, near Wicklow in Ireland, with native gold.

RED IRON ORE.* IRON GLANCE.

Red Iron ore presents itself under many varieties of form and colour; most if not all of which are very fee-

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of Schooley's Mountain in New-Jerſey, that ſurveyors are embarraſſed to find the true courſe by the needle of the compaſs. The load-ſtone affects it very much in certain places. Magnetical Iron Ore is found in many other places. Indeed, as the globe we inhabit exhibits ſuch ſtrong evidence of magnetical attraction, I entertain no doubt of the prevalence of iron, or of ſome other magnetical metal, throughout its denſe body, eſpecially in the northern hemiſphere.

* Pieces of the red ore of Iron, are frequently picked up along the coaſts of New-York. They are ſoft enough to be employed by the millers to make marks on barrels of flour, in addition to the brands from hot

bly magnetic: and though fragile, many of them are hard enough to scratch glass: they all afford a red powder. Iron Glance is considered, by many mineralogists, to be an oxide of iron, but not one variety has yet been analyzed. It occurs crystallized; in lamellæ; micaceous; in scales; in globular masses, and in stalactites; also compact and ochrey.

Chrystallized Iron Glance occurs under very different circumstances. It is abundantly found in the old and famous mines of the Island of Elba, in very brilliant and frequently, very large crystals; and in Saxony, Bohemia, Silesia, Switzerland, France, Norway, Sweden, and in Cornwall. It is also met with, principally in irregular and compressed crystals, in the fissures of the lavas of the Puy de Dome in France, of Vesuvius, also in the Lipari islands, and the volcano of Stromboli.

It affords an excellent malleable iron, but somewhat hard; and also a good, but not the very best, cast iron. Its specific gravity is about 5.

In *lamellæ* of a shining metallic lustre, it is met with in Caernarvonshire, and at Eskdale in Cumberland.

The *micaceous* variety is found principally with other ores of iron, and sometimes with coal; it occurs in minute scales of a reddish black colour, and unctuous to the touch. It is found in the Hartz, at Schemnitz in Saxony, &c. and at Tavistock in Devonshire, and Dunkeld in Perthshire; the *scaly* variety seems to differ very little from it.

Red Hæmatites Iron ore, is of a bluish grey colour, with a metallic lustre, and passes into brownish red; it occurs in globular and stalactitic masses, which internally have a fibrous diverging structure; and are sometimes in concentric layers. Its specific gravity is nearly 5. It

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irons. They were in all probability waſhed from the interior country, where iron ore abounds, to the sea coaſt, by the weight and preſſure of water that broke the barriers, and covered the alluvion of the ocean with another and more recent alluvion from the mountains.

My ſpecimens from Elba, are diverſified and elegant. Ore of the crystals has the faces of a mirror; and the ſides are ſo bright, that the face, the eye, and even a hair are reflected in the moſt perfect manner to the beholder. Quartz, opal, and ſhort-aſbeſtos (mineral cow-itch) accompanied my box of articles.

The micaceous ore of iron ore exiſts in New-York, Vermont, and various other places.

is found in Saxony, France, Silesia, and in England; very abundantly at Ulverstone in Lancashire; and in the Forest of Dean in Gloucestershire; but Norway, and other Northern countries, seem almost destitute of this variety. It affords excellent iron, both cast and malleable; most of the plate iron and iron wire of England are made of it. When ground to fine powder, it is largely employed in the polishing of metal.

The *Compact* variety is of a dark steel-grey, brownish, or blood red colour, and is found in mass, disseminated, &c. and sometimes in crystals that have taken the forms and places of those of other substances. It is found in France, Germany, Norway, Siberia, and at Ulverstone in England, and occurs both in primitive and secondary countries. It affords good cast iron, and malleable though somewhat soft, bar iron.

Reddle, Red Ochre, or *Red Chalk,* is of a blood red, passing into brownish red. It is dull, earthy, and is nearly without lustre. It generally accompanies the two preceding varieties. It is used in the arts. Near Platte in Bohemia it is smelted, and affords very excellent malleable iron.

BROWN IRON ORE.

Brown iron ore, like the preceding species, is found under several varieties of form; but does not resemble it in being slightly magnetic: all its varieties afford a brown powder. It is not certain wherein it differs from the Red Iron ore; most of the varieties of the Brown Iron ore have been proved to contain a small proportion of oxide of manganese, and this is supposed to constitute the difference between the two species. It also occurs scaly; in globular masses, and stalactites; also compact and ochrey.

The *scaly* variety seems to differ in its internal characters from the scaly variety of the red, only in being of a colour between steel grey and clove brown.

The *Brown Hœmatites*[*] is found under nearly the same circumstances, but not altogether in the same countries as the red; it yields a better cast iron than the brown; but the bar iron of the latter is both very malleable and very hard, probably from the manganese which it contains; hence it yields excellent steel. Though it is found in England, it does not occur in sufficient quantity to be wrought.

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[*] A compact variety of this ore, containing encrivites and shells apparently of the sea, was brought to me from Oneida, by Gov. D. W. Clin-

The *Compact* variety is found accompanying the preceding in the form of stalactites, and in masses of various shapes. It is remarkable in respect of its forming the substance of several petrifactions, as of madreporites and coralites. It is dull internally.

Brown Iron Ochre also accompanies brown hæmatites. It is destitute of lustre, and has an earthy fracture; it is tender, soils the fingers, and is of a yellowish brown colour. It does not contain any manganese.

BLACK IRON ORE.[*]

Black Iron Ore is a rare mineral of a bluish black colour; and is found globular, massive, &c. It is of a fine fibrous diverging structure, and has a glimmering and somewhat metallic lustre.

The *Compact* variety seems to have been found only in Saxony, Hesse, and some other parts of Germany, in primitive and secondary mountains, accompanying the preceding species. It was long confounded with compact grey manganese; but it yields a good iron which corrodes the sides of the furnace.

Black Hæmatites Iron ore has been found only at Schmalkalden in Hesse. In form it greatly resembles the Red Hæmatites, but differs in being more of a steel grey, and of a more delicately fibrous structure.

Neither of these varieties has been analyzed.

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ton. It is delineated in the laſt figure of the third plate of my Geological Memoir on North America.

[*] Is not the beautiful fibrous iron ore whoſe cryſtals radiate from centre to circumference, a variety of this ſpecies? I mean that ſort which is worked at Ancram; and whoſe lumps are found among the inland alluvial articles of Staten iſland.

CLAY IRON-STONE.[*] ARGILLACEOUS IRON-STONE.

Argillaceous Iron-Stone is of an ash grey colour, inclining to yellowish and bluish; also brown or reddish brown, which last colour is usually the effect of exposure to the atmosphere; some varieties have a slaty structure; some are glimmering, others dull. It occurs in globular masses, solid or pulverulent within; and in masses of various shapes, as columnar and lenticular, and in little rounded portions about the size of peas.

The *globular* masses, consisting of concentric layers either hollow, or enclosing a yellowish brown *pulverulent* substance, are termed *Ætites: externally,* these masses are very compact, hard and brown: they are found in argillaceous beds in some secondary countries, and sometimes abundantly disseminated in alluvial hills; and are occasionally accompanied by bituminized wood. Ætites consists of about 77 parts of peroxide of iron, 14 of water, 2 of oxide of manganese, 5 of silex, and 1 of alumine: it is found in Bohemia and Saxony; in France, in beds of sand and of ochre. It is frequently met with in the newer secondary rocks, and in the shale of coal formations; it occurs at Coalbrookdale in Shropshire, and Merthyr Tydvil in Wales, and in Scotland; at which places it yields an iron of a fine quality. It also occurs in Staffordshire, Yorkshire, &c.

The *Columnar* variety is of a brownish red colour, and is dull, soft, brittle and magnetic; it is met with in round masses and in columns. It occurs occasionally in beds of shale, above coal, and in many cases seems a pseudo-volcanic product, being accompanied by burnt clay, &c. and is met with in Germany in several places, and in the isle of Arran. It is not a common mineral, and is never wrought as an ore of iron.

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[*] Argillaceous iron ore is found in many places along the ſea coaſt and ſhores of New-York. It is found in the form of globular or roundiſh maſſes, which on being broken, are found to contain a kernel of ſofter matter, uſually ochreous, reſembling the yelk of an egg, within its ſhell.

Maſſes of this kind are frequently found, after having been accidentally broken. Through the fractured part, the friable internal core or kernel occaſionally eſcapes by waſhing and attrition, and leaves a cavity behind reſembling a tea-cup, an ink-ſtand, a hollow ſphere, &c.

Ferruginous iron, in the form of a baſaltic ore has been found at Plandome. (*Med. Rep. Vol.* 2, *p.* 219.) The form was an irregular pentagon, with truncated extremities, and ſomewhat convex ſurfaces.

Pea-iron ore from Egg Harbour, was ſhown me by John G. Bogert, Eſquire.

Granular iron ore, is common in the Highlands. The maſſes are about the ſize of peas, and the ſpaces are uſually filled by quartz. The conſtitution of the ore is very compact.

Pisiform or *Pea Iron Ore*, is mostly found in round grains of a dark brown colour; having an external polish, and internal earthy fracture, imbedded in a ferruginous, argillaceous, or calcareous cement. It is found in beds of clay, and in flat beds beneath the surface: but mostly in cavities in secondary limestone. It includes less iron, and more alumine and silex, than Ætites. It supplies very considerable iron works at Arau, near Berne in Switzerland; and the greater part of the French iron is said to be produced from this ore: but the iron yielded by it is said to be often of a bad quality, and very brittle.

BOG IRON ORE.*

Bog Iron Ore is of various shades of black and brown, and is generally of a soft earthy texture. It has obtained its name from its being chiefly met with in marshy places, or in those which have been so; it consists of about 66 parts peroxide of iron, 2 of oxide of manganese, 8 of phosphoric acid, and 23 of water. A variety which is nearly black is termed *pitchy*, and occurs massive, with a shining lustre; it contains about the same proportion of iron, combined with 8 of sulphuric acid and 25 of water. The earthy variety, which occurs in yellowish-brown cellular masses, has not been analyzed. It is found in Saxony, Prussia, Poland, and many parts

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[*] Bog-ore of iron abounds in North America. It is found on the iſland of New-York. It is worked into Bloomery-iron, near Ballſtown Springs. It ſupports the large iron works at Egg-harbour. It ſupplies great furnaces and forges on both ſides of the Cheſapeake, in Maryland. It is worked in many other places.

Part of it appears to have been brought to the ſtrata where it lies, partly by the waſh from the inland region, when the barriers which confined the interior ſeas or lakes, gave way; and partly by the chalybeate ſprings and oozings of water trickling over the ſoil, and depoſiting their iron.

of the north of Europe; in the Highlands of Scotland and the Orkneys. The acids contained in this species are supposed to have arisen from decayed vegetable matter; and it is believed that owing to their presence, the iron obtained from Bog Iron Ore is what is termed cold-short, and therefore can scarcely ever be used for plate iron, never for wire.

BLUE IRON ORE, OR PHOSPHATED IRON,*

Is of a pale or dirty blue colour: it occurs in slender rhomboidal prisms, which are of an earthy texture: when fresh dug it is white, but by exposure becomes blue; and has been found consisting of about 47 parts of oxide of iron, 32 of phosphoric acid, and 20 of water. It is usually found in small portions or nests in certain clays, bog iron ore, or peat. It occurs in France, Saxony, Poland, and Scotland; in Siberia, in fossil shells; in the lavas of Etna; and in England, in the river-mud at Toxteth near Liverpool, and in the Isle of Dogs on the borders of the Thames.

SPATHOSE IRON.†

Spathose Iron is of a white or yellowish grey colour, passing by decomposition into yellow, brown, and brownish black; when translucent, it has not the appearance of a metalliferous substance. It mostly occurs in rhombs, which are rarely perfect, and is found in veins, principally, of primitive mountains; it is sometimes accompanied by sulphuret of iron, yellow copper ore, grey copper, quartz, carbonated lime, &c. It is met with in Saxony, Hungary, &c. and in many places, in sufficient quantity for working as an ore of iron. At Schmalkalden in Hesse, there is a bed of the black variety 150 feet thick, which has been worked for several centuries ; and at Somororstro in Spain, there is a hill entirely composed of it. It occurs in small quantities in several of the mines of Cornwall. Spathose iron ore consists of 58 parts of oxide of iron, 35 of carbonic acid, 4.25 of oxide of manganese, 0.5 of lime, and 0.75 of magnesia. The iron obtained from it is particularly valuable, as it may be converted into excellent steel immediately from the state of cast iron ; the bar iron formed from it is both hard and tough.

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* There is an ore of iron, brought from Allentown, near Trenton, N. J. that is brown when dug out of the earth, but turns blue by expoſure to the atmoſphere. The colour is fine, and as Col. Trumbull believes, promiſes a valuable article for painters. It is compact, hard and amorphous, and contains no phoſporic acid. *(Cutbuſh, in Am. Min. Journal, p.* 86.)—

† I have American ſpecimens of the Spathoſe iron-ore; but do not now remember from what place they came.

SULPHATE OF IRON.* GREEN VITRIOL.

Sulphate of Iron is found in fibres of a whitish, greenish, or yellowish colour, occasionally of an emerald green colour ; it occurs massive, in stalactites, and pulverulent. It is also found crystallized in an acute rhomboid, according to Haüy of 81° 33′. and 98° 37′, which is the form of its primitive crystal ; it presents a few varieties of form. It is met with in most mines of sulphuret of iron, of copper, and of zinc ; the two latter being rarely exempt from iron.

CHROMATE OF IRON.†

Chromate of Iron has hitherto been found only massive : its aspect is somewhat metallic, and it is hard enough to cut glass ; it is of a blackish brown colour,

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* Copperas is found native in various places ; being formed chiefly from the decompoſition of pyrites. My abſtract of the manufactures of the United States, returned by the Marſhals of the ſeveral diſtricts, to the Secretary of State in 1810, contains the quantities of copperas, or vitriol of iron, manufactured in Vermont, New-Jerſey, Tenneſſee, and other ſtates. It is now underſtood that it may be prepared to any demand ; but the cheapneſs of the article imported from foreign parts, ſupercedes, in a great degree, the domeſtic manufacture. It was in a copperas cave that ſome of the Malay mummies were found. (*Miller in Med. Repos.*)

† Great quantities of this mineral exiſt near Baltimore, in Maryland.—It is browniſh, inclined towards a roſe-colour. Its uſual form is granular ; though ſometimes compact and maſſive. It is frequently bedded in Steatites, or Soap-rock. Beautiful yellow paint has been prepared by combining the chromic acid with lead —(*Keyser.*) A lamellated chromate of iron has been found in the neighbourhood of Philadelphia.

Solution of iron in water.—Chalybeate ſprings are very frequent in New-York and around. My experiments on that of Schooley's mountain, may and when reduced to powder, of an ash grey. It has been found in the Uralian mountains in Siberia; and since, in nodules and veins in serpentine, near Gassin, in the department of the Var, in France. The latter consists of oxide of iron 34 parts, chromic acid 43; alumine 20; silex 2. That of Siberia differs principally in containing 10 per cent. more of the chromic acid and 10 per cent. less of alumine: it also contains small portions of lime and of manganese.

ARSENIATE OF IRON.

This beautiful substance is rarely found massive, *but* mostly in cubes of various shades of green, yellow, and brown, sometimes nearly red; they are translucent, and occasionally almost transparent, but possess more of the appearance of an earthy, than of a metalliferous substance; by decomposition they become of a dull brown, lose their translucency, and at length assume the pulverulent form. The cube is considered to be the form of the primitive crystal; I possess seven varieties; and it is remarkable, in some of them, that only 4 of the 8 solid angles are replaced by planes; but in the more complex variety, each angle is replaced. This mineral is said hitherto to have been found only in some of the copper veins of Cornwall. In that called Huel Gorland, which is partly in argillaceous schistus and partly in granite, it was found in the same vein with native copper, and some of its ores, as the vitreous, red oxide, and arseniate of copper; also with arsenical pyrites, quartz, and fluate of lime; but the arseniate of iron was generally met with nearer to the surface than these substances. The arseniate of iron consists of 48 per cent of iron, 18 of arsenic acid, and 30 of water.

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be peruſed in the American Min. Journal, Vol. I. p. 77—78. My experiments and remarks on that of the Chappequa ſpring near Mount Pleaſant, contained in my letter to J. Smith, Eſq. repreſent it as a delicate ſolution of iron. My opinion of the mineral ſpring at Fluſhing, expreſſed in my note to Dr. Bloodgood, exhibits it as containing a higher charge of the ferruginous mineral, than is common. Several pumps in the city of New-York, afford ſtrong chalybeate waters. The like are frequent in the vicinity. There is a plenty of iron in the Ballſtown mineral water.

MANGANESE.

Manganese is so difficult to be obtained in the metallic state, that very little more is known of it than that it is of a whitish or iron grey colour, somewhat malleable, brittle, almost infusible, and that its specific gravity is nearly 7.

From the black oxide of manganese, * all the oxygen gas used by the chemist is obtained, and all the oxygen entering into the composition of the oxymuriatic acid consumed in the bleacheries of Britain, France, and Germany. The violet colour employed in porcelain painting is obtained from manganese. In glass-making, it is employed in the finer kinds of glass, both as a colouring material and a destroyer of colour: this application of it is ancient; it is mentioned by Pliny.

Manganese belongs perhaps rather more to primitive than to secondary countries. In the state of an oxide it is found combined in a very considerable number both of earthy and metalliferous minerals, though for the most part, only in very small proportions. It may be said to be found almost universally: it is met with both in the animal and vegetable kingdoms, and is an ingredient of mica, which is a constituent of the oldest of the primitive rocks.

Manganese is found in ores of great variety of aspect. They may be divided into four kinds.

GREY MANGANESE.

Grey manganese is either compact, acicular, or crystallized. When compact, it occurs in masses of various shapes, which are internally of a glistening metallic lus-

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* It has been found, in combination with iron, at Ancram, N. Y. For its particular hiſtory, ſee *Med. Repos. Vol.* 11, *p.* 442—3. Alſo diſſeminated among the rocks in the neighbourhood of Baltimore, (*Gilmor*, *American Min. Journal*, *p.* 232.) not far from Vergennes, in Vermont, (*Gibbs*) and in ſeveral other places.

tre; it is met with in France, Saxony, Piedmont, Bohemia, and at Upton Pyne in Devonshire, where it is called *Black-wad.* It has the singular property of inflaming spontaneously when mixed with one-fourth of its weight of linseed oil and set in a dry warm place It is compoposed of about 83 parts of oxide of manganese, 14 of barytes, together with some silex and carbon: its specific gravity is about 4.8.

The crystallized variety occurs in acicular, rhomboidal prisms, variously placed in regard to each other, but generally in radii. Haüy has described four varieties of their crystalline forms. It consists of the oxide of manganese, with an additional but variable proportion of oxygen. It is found in nearly the same places as the former variety, and at Mendip in Somersetshire, and near Aberdeen in Scotland. Both varieties are found in primitive, secondary, and alluvial countries.

SULPHURET OF MANGANESE.

The Sulphuret of Manganese is of a blackish or brownish grey colour, and has a shining metallic lustre when newly fractured. It occurs in mass; and is fine grained, and somewhat lamellar. It is met with at Nagyag in Transylvania, in the veins in which the ores of gold and tellurium are found, for which it serves as a gangue or matrix; it also occurs in Cornwall. It consists of 82 parts of oxide of manganese, 11 of sulphur, and 5 of carbonic acid: its specific gravity is about 4.

WHITE MANGANESE.

White Manganese is of a whitish, yellowish, or pale rose red colour; and is found in the same place, and under the same circumstance, as the preceding variety. It also occurs at Kapnic and Offenbanya, in masses of various shapes. It consists of 47 parts protoxide of manganese, 40 of silex, 4.6 of oxide of iron, and 1.5 of lime: its specific gravity is about 2.8.

PHOSPHATE OF MANGANESE.

The Phosphate of Manganese is a rare mineral, having hitherto been found only near Limoges in France, in granite, and in the same vein with beryls. It is of a reddish brown colour; is hard enough to scratch glass, and may be broken into rectangular prisms with square bases. Its specific gravity is 3.46; and it consists of 42 parts oxide of manganese, 31 of oxide of iron, and 27 of phosphoric acid.

MOLYBDENA.

Molybdena is a rare metal, which has never been found pure: it is with difficulty reduced to a pure state, and has only been obtained in brittle infusible grains of a greyish white. It is found combined in the metallic state with sulphur; and in the acid state with lead, in the state of an oxide, forming a mineral called Molybdate of Lead, described under that head.

SULPHURET OF MOLYBDENA.*

Sulphuret of Molybdena is nearly of the colour of fresh cut metallic lead. It is found massive, and disseminated, more rarely crystallized in six-sided prisms. It is opake, stains paper or the fingers, is very soft, laminated, and easily divisible in the direction of its laminæ; and is unctuous to the touch, and flexible: it yields by analysis 60 of metallic molybdena and 40 of sulphur.

It belongs exclusively to primitive countries, and is rarely found except in granite, in which it is sometimes disseminated, and therefore occasionally forms one of its constituent parts. It has been found in veins producing tin; and is generally accompanied by wolfram, quartz, and mica; less frequently by native arsenic, fluate of lime, topaz, &c.

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* The ſulphuret of Molybdena, is found frequently in the primitive rocks of New-York. It is foliated, ſhining, and flexible; and imparts a ſtain like black lead, readily, to paper and the fingers. I have ſpecimens from many places; and granite or gneiſs accompanies them all.

It is found disseminated in a grey granite at the foot of a rock called Talèfre near Mont Blanc. It occurs in the tin mines of Bohemia, in the Vosges, and Sweden: near Norberg, in the latter place, in a white steatite: in Iceland, in granite, of which the felspar is red. It has lately been discovered in Huel Gorland and some other mines of Cornwall; it occurs also at Coldbeck in Cumberland, at Shap in Westmoreland, and at Glen *Elg* in Invernessshire.

TIN.*

In its pure state, the specific gravity of Tin is about 7; but it has never been found pure. It is of a white colour, approaching that of silver; and is harder, more ductile, and more tenacious than lead; it is very fusible, and gives out a peculiar crackling noise while bending. It is the litghtest of the ductile metals. Tin was for a considerable time supposed to have been met with in the native or pure state; but it has been pretty well ascertained that the specimens which gave rise to the opinion, were found on the sites of old smelting works, whence these specimens have since obtained the name of *Jew's House Tin*. In the natural state, Tin is found as a nearly pure oxide, or combined, in that state, with small portions of oxide of iron and silex; it generally occurs crystallized; rarely in mass; sometimes in detached rounded pieces from the size of a grain of sand to that of a man's fist. It is also found in combination with copper, sulphur, and iron. Tin belongs exclusively to primitive countries.

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* Tin is mentioned as afforded by a mine, not very far from Kaſkaſkias. (*Med. Rep. Vol.* 7, *p.* 306.) My ſpecimens of Tin from Malacca and Banca, received from capt. Henry Auſtin, are in a powdery form and black.

The alloys of tin with other metals, are mentioned in treating of lead, copper, and quicksilver. Another will be noticed under the article Bismuth. In a fine leaf, as tin foil, it is used for many purposes ; its salts are used in dyeing : its economical purposes are well known.

OXIDE OF TIN.

Oxide of Tin rather resembles an earthy than a metalliferous substance. It occurs in nearly colourless and translucent crystals, and in crystals of various shades of yellow, brown, and black, which are either translucent or opake. The form of the primitive crytal, is an obtuse octohedron of 112°.10′ and 67°.50′, which has not hitherto been found uncombined with the planes of one or more of the several modifications to which it is subject: the crystals in my possession afford about 180 varieties of form, besides numerous compound crystals or macles.

Tin is by no means a universally diffused metal ; many countries are entirely without it : but it is found in Gallicia in Spain, and lately 2 or 3 veins have been discovered in a granite mountain in Brittany in France : it occurs also at Seiffen, at Geir, and at Altenberg in Saxony ; at Schlackenwald in Bohemia, in Banca and Malacca in the East Indies, and in Chili in South America : but most abundantly in the western parts of Devonshire and in Cornwall. Though Tin is the lightest of the ductile metals, it is remarkable that the natural oxide is one of the heaviest of the metalliferous ores : its specific gravity is nearly 7.

The oxide of Tin belongs chiefly, and almost exclusively, to the oldest of the primitive mountains, and is found in veins or beds, mostly the former, in granite, gneiss, and micaceous and argillaceous schistus. It is often found disseminated in granite. In veins and beds, it is accompanied by quartz, mica, lithomarga, talc, steatite, fluate and phosphate of lime, topaz, wolfram, arsenical pyrites, &c. which, like Tin, are considered to be among the substances of the most ancient formation. But it is said rarely to be found with carbonate of lime, sulphate of barytes, lead, or silver, which often accompany other metals. It is remarkable that in the veins of Cornwall, Tin is frequently found nearer the surface than copper.

In some of the valleys and low grounds of Cornwall, the oxide of Tin is found in grains and masses, rounded by attrition, which frequently bear the marks of crystallization. The tin is generally intermixed with, or covered by, the rubbish resulting from the disintegration of the rocks, which doubtless once held it in its native place. Small grains of gold are occasionally found with it. As in order to separate the tin from the alluvial matter, streams of water are passed over them: these deposites are called *Stream works;* one of the most remarkable of which is in a branch of Falmouth harbour.

In these stream works also a variety of the oxide of Tin is found, which has obtained the name of *Wood Tin*; which occurs sometimes in wedge-shaped pieces, banded with various shades of brown; and which, from their diverging and fibrous structure, appear to be portions of globular masses; they are mostly rounded by attrition. Minute portions of this variety have lately been met with in cellular quartz; they have a very silky lustre.

TIN PYRITES. BELL-METAL ORE. SULPHURET OF TIN.

This rare substance has only been found in the mine called Huel Rock in Cornwall, in a vein 9 feet wide, accompanied by sulphuret of zinc and of iron. Its colour is steel grey, passing into yellowish white: it has a metallic lustre and granular fracture, and yields easily to the knife. Its specific gravity is 4.3; and it consists of 34 parts of tin, 36 of copper, 25 of sulphur, and 2 of iron; but it does not seem to be ascertained in what manner the sulphur is combined with either of those metals.

TUNGSTEN.

Tungsten, called *Scheelin* by the French chemists and mineralogists, in honor of its discoverer, Scheele, is a hard, brittle, granular metal, of a light steel grey colour and brilliant metallic lustre. It is not found in the pure state; but only in the state of an oxide, principally combined with lime, forming a mineral, commonly, though improperly, called Tungstate of Lime; or in that of an acid, combined chiefly with iron; the latter combination is called Tungstate of Iron or Wolfram.

The ores of Tungsten are chiefly, if not exclusively, found in primitive countries.

TUNGSTATE OF LIME.

Tungstate of Lime completely resembles a stone; it is commonly translucent, limpid, and of a yellowish colour: it has a laminated structure; it considerably resembles carbonate of lead, oxide of tin, and sulphate of barytes. It occurs both in mass and crystallized. The primitive form of its crystals is that of the rectangular parallelopiped; it is more commonly found in the form of an octohedron. The varieties of form assumed by its crystals are not numerous.

It is commonly found in tin veins. It occurs in those of Saxony, Bohemia, Sweden and England; and is accompanied by wolfram, quartz, mica, &c.

The translucent crystals of this mineral are composed of oxide of tungsten 78 parts; of lime 18; and of silex 3: those of Cornwall contain a little iron and manganese.

TUNGSTATE OF IRON. WOLFRAM.

Wolfram is generally of a brownish black colour, and principally occurs in veins in primitive mountains, accompanying the oxide of tin; it somewhat resembles certain ores of iron, but is generally heavier; it is met with in mass, and crystallized. It may be cleaved into a rectangular parallelopiped, which therefore is considered to be the form of its primitive crystal; the varieties assumed by it do not exceed three or four.

It is met with in the tin veins of Saxony and Bohemia, at Puy les Mines in France, and abundantly in several of the tin veins of Cornwall. In the mine called Huel Fanny, near Redruth, Wolfam is met with in the form of the primitive crystal, but very minute.

By analysis Wolfram yields 67 parts of tungstic acid, 18 of oxide of iron, and about 7 parts of oxide of manganese.

TITANIUM.*

Titanium is so difficult of fusion, that the attempts to reduce it to a pure metallic state have scarcely succeeded. It is of a copper red colour.

Two of its ores are nearly pure oxides; in the others, Titanium, in the state of an oxide, is in combination with other metallic oxides, or with lime, and silex. Titanium belongs exclusively to primitive countries.

The only use to which titanium has ever been put, was in the porcelain manufactory at Sevres, where it was emplyed to produce the rich browns in painting it. The want of uniformity in colour occasioned its disuse.

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* The combinations of ſome of the ores of titanium, were firſt diſcribed with great care by Dr. Bruce, in his Mineralogical Journal, p. 232—243. He has given figures of *the oxyd* and the *Silicio-calcareous oxyd*, in their cryſtalline forms. To theſe two forms, and to that of the *ferruginous oxyd*, he refers all the ſpecies of titanium that he has ſeen. Four kinds were found on the iſland of New-York, in the limeſtone ridge near Kingſbridge. Two came from the vicinity of Richmond in Virginia. One from Worthington, Maſſachuſetts. One from the neighbourhood of Baltimore. One from an inſulated maſs of quartz in Bergen county, New-Jerſey. One from Ticonderoga. One from Lake George. Three from Staten-Iſland. One from Peekſkill. One from Wantage, New-Jerſey. There are many other places in the U. S. where titanium has been diſcovered.

TITANITE. RUTIL. RED SCHORL.

This mineral is of a brownish red colour, and is mostly opake, but occasionally is somewhat translucent, and is of about the hardness of quartz; it may be broken into a square prism with square bases, which therefore is the form of its primitive crystal. It is nearly a pure oxide of titanium.

It is generally found imbedded in quartz, sometimes in granite; the hair-like appearance traversing some crystals of quartz in every direction, are generally crystals of titanite. It is found almost exclusively in primitive countries, or in alluvial deposites in their neighbourhood.

It occurs in a schistose mountain near Mont Blanc, accompanied by carbonate of lime, and some ores of iron; at Rosenau in Hungary, and in New Castille in Spain, it is implanted in rock crystal in mountains of gneiss; at St. Gothard, it occurs in the cavities of granite, mixed with rock crystal, &c.: and near St. Yrieix in France, and in South Carolina in America, it is found in alluvial soil. It is met with also near Beddgelu in Caernarvonshire; and Cairgorm, and Craig Cailleach near Killin in Scotland.

ANATASE. OCTOHEDRITE.

Anataste is also nearly a pure oxide of titanium; it is found in octohedrons which are somewhat acute; Haüy has described four varieties of form to which it is subject: its colour is generally bluish or reddish brown. It it met with in the neighbourhood of Passau in Bavaria, at Bouen in Norway, at St. Gothard in Switzerland, and in the valley of Oysans in France, mixed with portions of granite.

NIGRINE.

In the Nigrine, the oxide of titanium is combined with about 14 of oxide of iron, and 2 of manganese. It is found in primitive rocks, often imbedded in them, in

Bavaria, Norway, in Mont Blanc, Mont Rosa, and in the granite of Egypt.

RUTILITE. SPHENE.

The Rutilite is composed of nearly equal parts of oxide of titanium, silex, and lime : it occurs in small crystals of a yellowish or blackish brown colour, in the form of rhomboidal prisms, terminated by 4 sided pyramids : it is also found in mass. It is met with nearly in the same places as the Nigrine.

MENACCANITE.

In the Menaccanite, which is found in grains of a bluish black colour, mixed with quartzose sand, in the bed of a rivulet at Menaccan in Cornwall, the oxide of titanium is combined with 54 parts of oxide of iron, a trace of oxide of manganese, and 3 of silex.

ISERINE.

In the Iserine, about 48 parts of oxide of titanium are combined with 48 of oxide of iron, and 4 oxide of uranium. It is found in angular masses and rolled pieces, near the source of the river Iser in the Reisengebirge, in granite sand; and in the bed of the river Don in Aberdeenshire in Scotland.

CERIUM.

Cerium, in its metallic state is scarcely known ; Vauquelin succeeded in procuring, by the reduction of one of its ores, a metallic globule, not larger than a pin's head. It was harder, whiter, much more brittle, and more scaly in its fracture, than pure cast iron.

Cerium has hitherto been found entering into combination in a few rare minerals, the other ingredients of which are principally earthy substances. The Cerite and the Alanite differ considerably in their composition; in both, the Cerium is in the state of an oxide.

CERITE.*

The Cerite was brought from the copper mine of Bastnaes, near Riddachyta in Sweden; the mine is situated in gneiss, and the Cerite was accompanied by the ores of copper, molybdena, and bismuth; and with mica, hornblende, &c.

It is generally of a pale rose colour, but sometimes inclines to brown. It occurs massive or disseminated; it is granular, brittle, and easily scratches glass; and consists of 54.5 parts of oxide of cerium, 34.5 of silex, 1.25 of lime, 3.5 of oxide of iron, and 5 of water.

ALLANITE.

The Allanite occurs in oblique four-sided, or compressed six-sided, prisms, of 117° and 63° terminated by four-sided summits: it also occurs massive, or disseminated in black mica, and felspar. Externally it is of a dull brownish black colour, and is opake and brittle. It was brought from Greenland, but nothing is known of its geological history; it obtained its name in honour of its discoverer, M. Allen of Edinburgh. It is composed of 33.9 parts of oxide of cerium, 25.4 of oxide of iron, 35.4 of silex, 9.2 of lime, 4.1 of alumine, and 4 of moisture.

Two minerals, one from Bastnaes in Sweden, the other from the Mysore, have lately been found among others brought from those countries, which have been found to contain cerium; the former has been analyzed by Berzelius, the latter by Dr. Wollaston; they considerably resemble the Allanite in composition. That from Bastnaes is called the *Cerin.*

URANIUM.*.

Uranium is a brittle, granular, hard metal, of extremely difficult fusibility.

It is remarakble that this metal has never been found in any state having a metallic appearance ; consequently never in the pure state.

It is of a dark grey colour, may be cut by the knife, and is, next to tellurium, the lightest of the metals ; its specific gravity being very little more than 6.

Its ores are only two in number : in both, it occurs in the state of an oxide : they are considered to belong to primitive countries. No use has hitherto been made of Uranium.

URANITE.

Uranite occurs principally in small crystals of various shades of yellow, green, and brown, which are sometimes transparent, sometimes opake. It is met with in nearly the same places and under the same circumstances as the uran-ochre. In France, at Chanteloube and St. Symphorien, and in two or three mines in Cornwall it is found in a friable granite. It is nearly a pure oxide of uranium.

At first sight the Uranite considerably resembles a variety of the arseniate of copper; but differs in the form of the crystal. The primitive crystal of the Uranite seems to approach the cube. Its crystals present several modifications. I possess 47 varieties of form, which are all from Cornwall. The variety from Gunnis Lake mine, near Callington in that county, exhibits quadrangular plates, very thin, of a beautiful green colour, and transparent.

The oxide of uranium is seldom found entering into the composition of other metalliferous substances, but is met with in a small quantity in the iserine, one of the ores of titanium.

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* Suppoſed to exiſt in the form of *earthy green oxyd*, near Baltimore, and at Brunſwick Maine. (*Cleaveland.*)

URAN-OCHRE. PITCH-BLENDE.

Uran-ochre is mostly of a brown or brownish black colour; it occurs globular or massive, is sometimes disseminated, or pulverulent: it frequently resembles pitch, and is very brittle. It consists of 86.5 parts of oxide of uranium, combined with 6 of galena, 2.5 black oxide of iron, and 5 of silex.

It is met with in veins of copper, lead, silver, &c. in Bohemia, Saxony; and in two or three of the copper veins of Cornwall, passing through a friable granite.

TANTALIUM; OR, COLUMBIUM.*

Tantalium is a metal, having but a slight external metallic lustre; it is dull and almost black internally; its specific gravity is little more than 6.

It is only found in the state of an oxide combined with other substances; its ores are only two. They have been found only in a primitive mountain.

TANTALITE.

The Tantalite is found principally in crystals in the form of an acute octohedron, and of a bluish grey or iron black colour. It occurs disseminated, in globular masses, in a vein composed of red felspar, traversing a mountain of gneiss, near Brokaern in Abo in Finland. It has a metallic lustre when broken; and is composed of 83 parts of oxide of tantalium, 12 of oxide of iron, and 8 of oxide of manganese: its specific gravity is 7.9.

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* As ſoon as it was known that an American mineral had afforded a new metal, I endeavoured to make known the particulars, by a ſtatement of them in a periodical work of ſcience. (6 *Med. Rep. p.* 212—323.) I employed all the means in my power to diſcover the place whence Gov. Winthrop's ſpecimen, found by Mr. Halchett, in Sir Hans Hoane's collection, might be ſuppoſed to have been taken. After about two years of inquiry, his deſcendant, Francis B. Winthrop, Eſq. of New-York, gave me reaſon to believe the mineral in queſtion was originally found near a ſpring at Nautneague, a place where Gov. Winthrop uſed to live, about 3 miles from the margin of the ſalt-water, at New-London Harbour. (8 *Med. Repos. p.* 437.)

YTTROTANTALITE.

The other compound mineral in which tantalium is found is called the Yttrotantalite, from its also containing a portion of the rare earth Yttria. It is found at Ytterby in Sweden, in a vein of felspar with the gadolinite; it occurs disseminated in masses about the size of a nut. It is nearly black; when broken, it is of a shining metallic lustre, and granular. The Yttrotantalite consists of 45 parts of oxide of tantalium, and 55 of yttria and oxide of iron: its specific gravity is 5.1.

CHROME.*

Chrome is a metal of a greyish-white colour, and extremely brittle; it is remarkable that it has never been found in the metallic form, either pure or combined with any other substance, but only in the acid state, or in that of an oxide.

The chromic acid is found in combination with lead, forming a compound mineral called chromate of lead, already described.

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* Chromate of Iron is found in large quantities at the bare hills, 7 miles on the Falls turnpike, maſſive and granular, in veins and lumps diſſeminated through a ſerpentine rock. Perhaps in no part of the world, has ſo much been diſcovered in one place. It furniſhes the means of preparing the beautiful paint called the chromic yellow, with which the carriages and furniture are now painted, in Baltimore. (*Gilmor.*) It is found alſo in octohedral cryſtals, very ſmall and magnetic, along the ravines and among the ſand of rivulets, mingled with the granular chromate of iron.—(*ibid.*) It is preſumed the red, green, yellow and purple, of the Staten-iſland ſteatites, near New-York, may be derived from Chrome.

The Chromic acid enters into the composition of the spinelle ruby.

The Oxide of Chrome is found in combination with iron; forming a compound already described as chromate of iron. It is also found in the emerald, and in two or three other earthy minerals; it has likewise been detected in some of the meteoric stones, or aerolites.

Chrome, as obtained in the metallic state by the chemist, from either of the foregoing compounds, has not been applied to any important use: it tinges glass of a green colour. It has been ascertained that the emerald owes its beautiful green colour to oxide of chrome: it seems therefore probable that chrome may hereafter be employed as paint.

BISMUTH.*

Bismuth is of a reddish-white colour, and very brittle. Its specific gravity is nearly 10.

It is found in the pure or native state somewhat alloyed by arsenic.

The ores of Bismuth are few; in one of them it is combined with sulphur; in another with inferior portions of other metals, and with sulphur. It is also met with combined with oxygen. All its ores are considerd to belong exclusively to primitive mountains.

Bismuth is very little used, but it enters into the composition of some of the soft solders, and of sympathetic ink. It forms alloys with other metals. Tin and bismuth are two of the most fusible metals. The fusible metal of Sir Isaac Newton, is composed of 8 parts of bismuth, 5 of lead, and 3 of tin; when this is thrown into water and heat applied, it melts a little before the water has reached the boiling point.

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* Native Biſmuth in brilliant plates, interſperſed through a vein of quartz, has been found in Huntington, Connecticut. The largeſt plate is not more than an inch in diameter, and its ſurface beautifully reticulated. (*Silliman in Am. Min. Journal. p.* 267.)

NATIVE BISMUTH.

Native Bismuth is of a silvery white, tinged with red; and occurs massive, dendritical, and crystallized in the regular octohedron, which is considered to be the form of its primitive crystal; also in cubes, and in the form of an acute rhomboid. It is rarely quite pure, but mostly contains a small portion of cobalt or arsenic: it is sometimes so disseminated throughout its gangue or matrix, as to be scarcely perceptible; but on subjecting it to heat, globules of Bismuth appear on the surface. Its specific gravity is about 9.

It is met with in Bohemia, Saxony, France, Swabia, Transylvania, Sweden, and in Cornwall; it chiefly occurs in veins in primitive mountains in a gangue of quartz, calcareous spar, sulphate of barytes, indurated clay, or of jasper, and is accompanied by ores of cobalt and nickel, and sometimes of silver, zinc, and lead.

SULPHURET OF BISMUTH.

Sulphuret of Bismuth is of a colour between tin white and lead grey, and is found massive and acicular; it is splendent and shining, and brittle. It consists of 60 parts of bismuth, 36 of sulphur, and a little iron; but in some specimens, the proportion of sulphur does not amount to more than 5 per cent. Its specific gravity is about 6.

It is a rare mineral; but has been found at Joachimsthal in Bohemia, at Schneeburg in Saxony, and at Bastnaes in Sweden, in a gangue of quartz; in spathose iron ore, at Biber in Hesse; and in Cornwall.

It resembles sulphuret of antimony in colour and is liable to be mistaken for it.

A variety, of a dark steel grey colour, has been found to consist of about 43 parts of bismuth, 24 of lead, 12 of copper, 1 of nickel, 1 of tellurium, and 11 of sulphur, and has therefore been termed *Plumbo-cupriferous sulphuret of Bismuth.*

Another variety of a steel grey colour has yielded about 47 parts of bismuth, 35 of copper, and 13 of sulphur, and has received the name of *Cupriferous sulphuret of Bismuth.*

BISMUTH OCHRE. OXIDE OF BISMUTH.

Bismuth ochre occurs both massive and pulverulent, and is of yellowish grey colour, tinged with green. It is readily reduced on charcoal to the metallic state, and is therefore considered to be a pure oxide of bismuth: its specific gravity is 4.37.

It is very rare; and has been principally found at Schneeburg in Saxony, accompanying native bismuth. It has also been met with in Cornwall.

ARSENIC.*

Arsenic, when pure, is of a bluish white colour; but, by exposure to air, becomes at length almost black. Its specific gravity is above 8. It is extremely brittle, and has a granular fracture.

Arsenic is a metal of very frequent occurrence: it is found nearly pure, when it is called Native Arsenic, and in combination with most other metals: its presence, when in considerable quantity, may be detected by exposing the substance to heat, or by striking it with a hammer, which cause the arsenic to give out an odour like that of garlic. It is also found in combination with oxygen; with sulphur; and in the state of an acid, with some of the metals, and also with lime.

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* Arſenic, in the form called White Pyrites or Arſenical Pyrites, is occaſionally found adhering to quartz, in primitive rocks. My ſpecimens of Miſpickel, from Warwick, in Orange County, N. Y. are in roundiſh lumps of different magnitudes, from that of a man's fiſt, to that of a moderate ſized melon. Externally, the maſſes are rough and tarniſhed; but within, they exhibit a tin-coloured luſtre. They are very heavy; and readily emit garlic-flavoured vapours of a white colour, by expoſure to even a moderate heat. My informant ſaid there was a great quantity there.

Arsenic belongs chiefly to primitive countries.

NATIVE ARSENIC.

Native Arsenic is found only in veins in primitive mountains. It is of a greyish white colour and metallic lustre; but by exposure becomes dull; it occurs in irregular masses: it is nearly pure, being alloyed only by a very small proportion of iron, or of gold or silver. Native arsenic is composed by some of the ores of silver, cobalt, lead, nickel and iron; also by carbonate and fluate of lime, quartz, and some other substances. It is usually found in masses, somewhat round: never crystallized.

It occurs in the mines of St. Marie aux Mines in France, in those of Freyberg in Saxony; and of Bohemia, Cornwall, and Siberia.

OXIDE OF ARSENIC.

Arsenic in the state of an oxide occurs in the prismatic, acicular, and pulverulent form, in the mines of Hesse, Saxony, Hungary, and in a cobalt mine in the Spanish Pyrennees. It is also found as an efflorescence in the fissures of the lavas in some volcanic mountains.

REALGAR. ORPIMENT. SULPHURET OF ARSENIC.

Arsenic in the metallic state, combined with sulphur, forming sulphuret of Arsenic, is termed, when of a red colour, Realgar; when yellow, Orpiment.

Realgar is of a red colour, passing into scarlet, or orange. It is found disseminated, in mass, or crystallized. Its primitive crystal is the same as that of sulphur, an acute octoheron. Haüy has mentioned six varieties of its crystals. It is very tender and brittle.

It occurs in the primitive mountains of Germany, Switzerland, Hungary, Saxony, and Transylvania. De Born mentions a vein of it between Galicia and Transylvania, about twelve feet thick. It occurs also in the vicinity of volcanoes, as of Etna, Vesuvius &c.

It is employed as a paint; and in Siberia, it is given as a medicine in intermittent fevers.

Orpiment is of a bright lemon or golden yellow colour; it is found disseminated; in mass; or crystallized in octohedrons, which are not well defined. It seems rather to belong to stratified or secondary mountains than primitive; and is sometimes accompanied by realgar.

It occurs in Moldavia in Hungary, in a vein of Pyritous copper; and in a ferruginous clay at Thajoba; it is also found in Transylvania, Georgia, Wallachia, and Natolia.

It is employed as a paint. The Romans used the bright gold coloured orpiment from Syria for that purpose, and esteemed it highly.

Realgar consists of 75 of arsenic, and 25 of sulphur: Orpiment, 57 of arsenic, and 43 of sulphur.

MISPICKLE. ARSENICAL PYRITES.

This substance is of a silvery or yellowish white, and occurs in mass, disseminated, or crystallized, in almost all metalliferous primitive mountains; and abounds in many of the tin and copper veins of Cornwall. A specimen analyzed by Thompson yielded 48.1 of arsenic, 36.5 of iron, and 15.4 of sulphur; another analyzed by Berzelius yielded only arsenic, and iron.

A variety containing from one to ten per cent. of silver, is found only at Freyberg in Saxony.

The primitive crystal of Mispickel is considered to be a right rhomboidal prism. It is subject to several modifications; the crystals in my possession exhibit the planes of 7 modifications, combined in 34 varieties of form.

COBALT.*

Cobalt is of a grey colour, with a tinge of red, and has the magnetic properties of iron: it is very difficult of fusion; its specific gravity is about 8.

It has never been found in the pure, or native state; but is mostly combined with arsenic and sulphur; sometimes mineralized by the sulphuric acid, &c.

The ores of cobalt occur in veins both in primitive and in secondary mountains: mostly accompanied by some of the numerous ores of copper, sometimes by native bismuth, native silver, native arsenic, and the ores of silver.

In Cornwall, cobalt occasionally occurs in copper veins; sometimes in those of a contrary direction. In one of the latter description, it is found in a mine called Huel Sparnon, near Redruth, (which is situated in argillaceous schistus) combined with bismuth, nickel, arsenic and sulphur: a block, principally consisting of these substances, which weighed 1333 lbs. was lately raised from that mine.

Cobalt is very little used except in the arts. It is brought to this country reduced to the state of an oxide, of an intense blue colour, called *zaffre*, which when melted with 3 parts of sand and 1 of potash, forms a blue glass, and when pounded very fine is called *smalts*, and is then employed to give a blue tint to writing papers, and in the preparation of cloths, laces, linens, muslins, &c.; for colouring glass, and for painting blues on porcelain. So intense is the blue of zaffre, that one grain will give a full blue to 240 grains of glass.

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* A conſiderable quantity of ore from the Cobalt mine at Chatham, near Middletown in Connecticut, was brought to New-York a few years ago. The metal is diſſeminated through a very ſolid rock, of the hornblende kind. It appears in ſhining veins and ſpecks, almoſt reſembling arſenical pyrites. The colour of the rock is greeniſh.

GREY COBALT.

The *Bright White Cobalt* of Aikin is commonly called Grey Cobalt. It is of a nearly silver white colour, but has a slight reddish tinge : it occurs crystallized; yields with difficulty to the knife; is brittle; attracts the magnetic needle; gives a spark by the hammer, and yields a garlicky odour. It occurs in masses of various shapes, and in crystals of great regularity. The form of the primitive crystal is considered to be the cube; the crystals in my possession exhibit the planes of four modifications in 22 varieties of form, remarkably resembling those of the sulphuret of iron.

It consists of 44 parts of cobalt, 55.5 of arsenic, 0.5 of sulphur: its specific gravity about 6.4.

It is found in Norway; at Tunaberg in Sweden; Annaberg in Saxony; also, though rarely, in Swabia and Stiria. In Soxony and Norway, it is contained in beds of micaceous schistus, and is accompanied by quartz, pyrites, &c.

The Grey Cobalt of Aikin, and which is of a steel grey colour, hard and brittle, is found in several of the copper veins of Cornwall: it is generally compact and massive, and has much the aspect of native arsenic. It consists of 20 parts of cobalt, 24 of iron, 33 of arsenic, together with some bismuth and earth, and appears to be a variety of arsenical cobalt.

ARSENICAL COBALT.

This mineral is of a shining white colour, and is found in masses of various forms, and crystallized in the form of the cube: Haüy describes four varieties in the form of its crystals, which pass into the octohedron. It does not attract the magnet. It is found in some of the copper veins of Cornwall; also in France and Spain; at Annaberg and Schneeberg in Saxony; and in Bohemia, &c. Klaproth says that it contains arsenic, iron, and sometimes silver and nickel. It is heavier than grey cobalt; its specific gravity being 7.7.

EARTHY COBALT.

Earthy Cobalt is of various shades of yellow, brown, and black. It has no metallic splendour; it sometimes occurs in masses, sometimes almost pulverulent, and is remarkably lighter than the preceding variety, not being equal to half its weight. It has not been analyzed, but the cobalt is considered to be in the state of an *oxide* in this variety.

It is found in some of the Cornish mines; and at Alderly Edge in Cheshire in red sandstone. It is also found in Saxony, at Schneeberg and Kamsdorf; and in the Tyrol, Thuringia, &c.

RED COBALT.

Red Cobalt is also called *arseniated Cobalt*, on account of its being supposed to be cobalt mineralized by the arsenic acid: but it has not been analyzed. It is also called *Cobalt Bloom*, and passes from nearly white, through peach bloom, to a crimson red colour: it is found in small quantity in silver and copper veins. It is said to have been found in Cornwall; in Stirlingshire; and near Edinburg.

RED VITRIOL. SULPHATE OF COBALT.

Red Vitriol has been found only at Hessingrund near Neusohl in Hungary, in the form of translucent stalactites of a pale rose colour, and enclosing drops of water. It consists only of cobalt mineralized by the sulphuric acid.

NICKEL.*

Nickel is of a yellowish white colour; it is attractable by the magnet, though in a degree considerably less than iron; it is ductile, and nearly as malleable as silver; its specific gravity is about 9. It has never been found pure, and its ores are only two in number.

It is remarkable that nickel, which is one of the least abundant metals, has been found by analysis to enter into the composition of meteoric iron, and of all those stony substances which in various parts of Europe and America, have fallen from the atmosphere; whence they are termed meteoric stones.

The uses of nickel are not numerous; it is chiefly employed in alloys with other metals.

KUPFERNICKEL. COPPER NICKEL.

Kupfernickel is of a pale copper-red colour, and is commonly found massive; its fracture is granular, with a metallic lustre; it yields with difficulty to the knife, but is brittle. It is hard enough to give sparks by the steel, giving out an arsenical odour. It has not been analyzed; but it is ascertained that it consists principally of nickel and arsenic, combined with sulphur, iron, cobalt and bismuth.

It is most abundantly found at Joachimsthal in Bohemia; Schneeberg, Freyberg, and Annaberg, in Saxony; and Andreasberg in the Hartz. It is also met with in Cornwall; at Allemont in France; in Stiria; in Arragon in Spain; and at Kolywan in Siberia. It is met with principally in veins in primitive mountains, accompanying the ores of silver, cobalt and copper.

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* I have ſtrong reaſons to believe Nickel is only a modification of iron; though the great authorities lean the other way, favouring the notion of its being a diſtinct metal. So it is now to be conſidered.

It is reported on good evidence that nickel accompanies copper in Maryland, and cobalt in Connecticut. It was an ingredient in the atmoſpheric ſtones, that fell at Weſton in Connecticut, in Dec. 1807, in ſuch combination that the metallic iron, which was a large ingredient in the ſtone, was believed to be moſtly alloyed by nickel. (11 *Med. Repos. p.* 202—213.)

NICKEL OCHRE.

Nickel Ochre has only been met with in the pulverulent form, generally investing the preceding ore of nickel, and sometimes the ores of cobalt. It has been detected in the chrysoprase (to which it probably imparts its green colour.) and in the soft green substance in which it is found.

It is considered to be an oxide of nickel: but has not been analyzed.

SILVER.*

Silver, when pure, is soft, opake, and flexible; a piece one-tenth of an inch in diameter will support two hundred and seventy pounds without breaking. Its specific gravity is about 10. It is very white, shining, and malleable, and is found in the pure or native state; its ores are numerous. It occurs combined with antimony, iron, arsenic, lead, copper, bismuth, alumine, and silex; and mineralized by sulphur, and by the carbonic, sulphuric, and muriatic acids.

The ores of silver, whatever may be their composition, are principally met with in primitive rocks, but not of the oldest formation; they are also found in veins in secondary rocks; but never in alluvial deposites. Silver therefore is not regarded as being one of the most ancient metals.

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* Native Silver was diſcovered at Singſing, N. Y. and the mine worked as long ago as 1775. When I viſited the ſpot in 1816, the ſhaft and every part was filled with water. A few ſpecimens of the native ſilver found there are ſtill extant. There is a little piece in my collection. The quantity was very ſmall, and the adventurers loſt money by the undertaking. Inconſiderable quantities have been obſerved in a few other places. A rich collection from Chili, was made by Mr. Taber, and brought to New-York. I ſaw theſe ſuperb ſpecimens ſeveral times. It is ſaid that ſilver exiſts in the copper of the Schuyler mine, near New-York, to the amount of from 4 to 7 ounces in 100 lbs.—*(6 Med. Repos. p. 319.)*

The mines of Peru and Mexico furnish annually ten times more silver than all the mines of Europe united.

According to Helms, the mine of Jauricocha, in Peru which is about three miles above the sea, contains a prodigious mass of porous brown iron-stone, half a mile long, as much broad, and about one hundred feet in depth, which is throughout interspersed with pure silver; and contains a white argillaceous vein, which is very much richer. It is asserted that Jauricocha and the mines of the district surrounding it, have yielded forty millions of dollars in a year.

The uses of silver are numerous, and for the most part obvious. In coin, silver is alloyed by one part of copper to fifteen of silver. The yellow colour, used in porcelain painting, is oxide of silver.

NATIVE SILVER.

Native silver, when pure, is white, and has a shining metallic lustre, but it is generally tarnished externally; it is soft, flexible, and malleable; it occurs massive, capillary, ramose, and crystallized in cubes and octohedrons; but as the structure of the crystals is not of that description which admits of regular cleavage, their primitive form has not been determined. It is less malleable than silver that has been melted in the furnace, on occount, as it is supposed, of its being generally alloyed with small portions of other metals; as gold, copper, arsenic, and iron. A specimen assayed by Dr. Fordyce, yielded 28 per cent. of gold: when this metal is mixed with it, the colour approaches to that of pale brass; when alloyed by copper, it has a tinge of red.

Native silver has been found in rocks of almost every description; principally in the newer primitive. In the mines of Kongsberg in Norway, now almost exhausted, it was found in carbonate and fluate of lime, &c.; at Schlangenberg in Siberia, on sulphate of barytes: at Allemont, it is disseminated in a ferruginous clay. In Cornwall, it was found in the Herland mine imbedded in a soft marl, and accompanied by sulphuret of lead, cobalt, quartz, &c. in a vein passing through argillaceous schistus: this vein ran north and south, intersecting veins of copper, which always in Cornwall run east and west. But native silver is found in Europe, most plentifully in the mines of Saxony, Bohemia, and Swabia.

ANTIMONIAL SILVER.

Antimonial Silver is of a yellowish white, has a shining metallic lustre, and is often tarnished externally: it occurs in grains, massive, and crystallized in prismatic, but not very determinate crystals. It consists of silver united with antimony in variable proportion; but the former, according to two analyses, is not less than 77 per cent. of the mass. It is not abundant; but is met with in veins of calcareous spar and sulphate of barytes, accompanied by native silver, sulphuret of lead, &c. at Guadalcanal in Spain, and in Swabia.

An ore consisting of about 12 parts of silver, united with about 44 of iron, 35 of arsenic, and 4 of antimony, is called *Arsenical Antimonial silver*.

SULPHURET OF SILVER. VITREOUS SILVER.

This mineral is of a dark metallic lead grey colour, and is often tarnished externally; it is soft, malleable, easily cut by the knife, and occurs of indeterminate shapes, capillary, ramose and crystallized in the cube, octohedron and dodecahedron; but not admitting of regular cleavage, the primitive form of its crystal has not been determined. It consists of 85 parts of silver, and 15 of sulphur. Its tenacity is so great, that Augustus, king of Poland, had some medals struck of it.

It occurs in veins, mingled with other ores of silver, and accompanied by native silver, sulphate of barytes, and sulphuret of lead, iron, copper and zinc. It is found in the Saxon, Bohemian, Swabian, Hungarian and Norwegian mines, and it is said to have been found in Cornwall: but the most brilliant specimens are brought from Siberia, consisting of groupes of crystals covered by capillary native silver, 2 or 3 inches in length.

RED SILVER. RUBY SILVER.

This mineral is of a brilliant red colour, and is frequently transparent; it occurs dendritic, massive, and crystallized, generally in the hexahedral prism, which is sometimes modified; it assumes about 40 varieties in the forms of its crystals, the primitive of which is an obtuse rhomboid of 109° 28′ and 70° 32′, according to Haüy. It is brittle, yields easily to the knife, and consists of about 70 parts of sulphuret of silver, combined with about 29 parts of sulphuret of antimony. It is usually found in veins, mingled with other minerals; such as sulphuret of lead, cobalt, native arsenic, realgar, grey copper, spathose iron, iron pyrites, sulphuret of zinc, &c. and is met with in all silver mines; but principally in those of Freyberg, St. Marie-aux-mines, and Guadalcanal, &c.

BRITTLE SULPHURET OF SILVER. BRITTLE SILVER GLANCE.

The colour of this mineral is dark grey, passing into iron black, and is of a bright and shining metallic lustre externally; it is soft and brittle, and occurs massive, and in hexahedral prisms variously terminated, and in quadrangular tables. It consists of 66.5 parts of silver, 10 of antimony, 12 of sulphur, 5 of iron, 0.5 of copper and arsenic, and one of earthy impurities. It is met with in veins containing some other ores of silver and sulphuret of lead, &c. in Hungary, Transylvania, Saxony, Bohemia, Peru, &c.

WHITE SILVER.

White silver is of a light lead grey colour, passing into steel grey; it is found massive and disseminated, and has a metallic lustre; it is soft and somewhat brittle. Its specific gravity is 5.3; it consists of 48.06 of lead, 20.4 of silver, 7.88 of antimony, 2.25 of iron, 12.25 of sulphur, 7 of alumine, and 0.25 of silex. It has been procured from the mine Himmelfurst near Freyberg in

Saxony, where it was accompanied by other ores of silver, and with antimony, brown spar, and calcareous spar. Some specimens have been met with passing into brittle sulphuret of silver; others into plumose antimony.

BLACK SILVER.

Black silver is iron black, passing into a steel grey colour; it occurs disseminated, massive, and crystallized in tetrahedrons; it is somewhat hard, brittle, and has a shining metallic lustre. It is by some considered to be an argentiferous variety of the sulphuret of copper.

BISMUTHIC SILVER

This mineral is of a light lead grey colour, which becomes deeper on exposure to the air: it occurs disseminated, rarely massive, and consists of 33 parts of lead, 27 of bismuth, 15 of silver, 4.3 of iron, 0.9 of copper, and 16.3 of sulphur. It has only been found in a mine in the valley of Shapbach in the Black Forest; and was accompanied by quartz, hornstone, and copper pyrites.

CARBONATE OF SILVER.

Carbonate of silver is greyish, passing into iron black, and has a glimmering or shining metallic lustre. It is soft, somewhat brittle, and heavy; and consists of 72.5 per cent. of silver, 12 of carbonic acid, 15.5 of oxide of antimony, and a trace of copper. It was found about thirty years ago, accompanied by native silver, sulphuret of silver, and grey copper, in a vein of sulphate of barytes at Altwolfatch.

HORN SILVER. MURIATE OF SILVER.

This mineral is of a pearl grey colour; occasionally it is greenish blue or reddish brown, and is remarkable for being so soft as easily to take the impression of the nail, and for its translucency. It has a waxy lustre; is fusible in the flame of a candle, and is generally found investing and massive, rarely crystallized in small cubes. The massive consists of 88.7 per cent. of muriate of silver, six of oxide of iron, 1.75 of alumine, and 0.25 of sulphuric acid. It has been found at Andreasburg in the Hartz, in the Mexican, Peruvian, Saxon, and Bohemian mines; those of Johngeorgenstadt formerly afforded large quantities of it. It is also met with in Hungary at Schemnitz; in France near Allemont, and in several mines in Cornwall, though not abundantly. It has been remarked that Horn silver is commonly met with near the surface in veins, and frequently with organic remains.

A variety is met with of a brownish white, but externally of a slate blue colour; it is massive, dull, opake, and earthy; and consists of about 33 parts of muriate of silver, combined with about 67 of alumine. It is called *Buttermilk silver*, and is found at Andreasberg in the Hartz.

COPPER.[*]

Copper, in its pure state, is so tenacious, that a wire one-tenth of an inch in diameter will support two hundred and ninety-nine pounds and a half, without breaking: its specific gravity is about 8.

Copper is harder and more elastic than silver; and is the most sonorous of metals: in respect of fusibility it is between gold and iron. It is of a pale red colour, with a tinge of yellow. Its ores are numerous. It occurs in the pure or native state ; also combined with iron, antimony, silver, arsenic, and with silex, lime, and water, and mineralized by oxygen, sulphur, and by the carbonic, muriatic, phosphoric and arsenic acids.

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[*] Native Copper has been found in many places. I mention a few of the localities.—In conſtructing the fortifications at the Narrows on Staten-iſland, between the city of New-York and the ocean, ſeveral pieces of native copper were found by the workmen in that alluvial ſoil. The parcels were buried at different depths. Mr. Dawſon brought me ſmall flatted pieces of native copper from Virginia, which, if I recollect right, were found near Frederickſburgh. At Woodbridge, N. J. there is a native copper of remarkable beauty.

The greater part of the ores of Copper seem to belong chiefly, though not exclusively, to primitive countries ; and are found both in veins and in beds. Native copper, the red oxide, the sulphuret, yellow copper, grey copper, and the arseniate, have been found principally in these countries ; the localities of the phosphate and muriate are less known ; but the variety of green carbonate, termed Malachite, is said to have been met with in every variety of country The mines of Tunaberg in Sweden, and some others, as well as that of Ecton in Staffordshire, (which yielded the yellow copper ore) are situated in compact limestone. The mines of Cornwall are situated both in argillaceous schistus and granite.

Veins containing copper are not esteemed to be of so ancient formation as those enclosing tin ; because, when the veins meet with each other, those of tin are always traversed by those of copper ; but the ores of both these metals are often found in the same veins in Cornwall : the copper being generally beneath the tin.

Mines of Copper are largely wrought in England, Germany, Sweden, and Siberia : those of Spain, France, Ireland, Norway, and Hungary, are much less extensive and numerous. Copper has been found in Asia, Africa, and America, in considerable abundance.

The uses of copper in all its various states are almost endless, and only, if at all, inferior to those of iron. Alloyed with certain proportions of zinc it forms brass, pinchbeck, tinsel, and Dutch gold, in imitation of gold leaf. With a small proportion of tin, copper forms bronze or bell metal ; but if the proportion of tin amount to one-third, it forms speculum metal, used for reflecting telescopes. With zinc and iron, it forms tutenag. In porcelain painting, the green is obtained from copper.

NATIVE COPPER.*

Native copper is of a yellow red colour, has a metallic lustre, and is often tarnished externally of various colours; it occurs massive, capillary, dendritic, and crystallized, and is malleable and flexible. It assumes the form of the cube and of the regular octohedron; but not possessing that structure which allows of regular cleavage, either of these solids may be considered as the primitive form of its crystals, which are very numerous, but not very intelligible, on account of their extreme liability to that kind of compound structure which constitutes the macle. The crystals in my possession exhibit about 80 varieties of form, and were all brought from Cornwall ; where Native Copper has occasionally been found in considerable abundance, accompanied by the red oxide, (into which it sometimes passes,) and occasionally by the green carbonate and the arseniate of Copper; and by quartz and fluate of lime. The copper veins of Cornwall are situated both in argillaceous schistus and granite. Native Copper is occasionally found disseminated in the serpentine of the Lizard point in that county.

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* There is reaſon to believe, that native copper exiſts in larger blocks or maſſes, on the ſouth ſide of Lake Superior, than in any other part of the world. It is found too at Green Bay, on the weſt ſide of Lake Michigan. I have ſpecimens of both. The metal is remarkably pure, as appears by the following analyſis, made at the mint of Utrecht, in the Netherlands, at the requeſt of Dr. Euſtis, the Miniſter Plenipotentiary of the United States, who carried ſpecimens with him to Europe.

The report from the mint, is in theſe words :—" From every appearance, the piece of copper ſeems to have been taken from a maſs that has undergone fuſion. The melting was, however, not an operation of art, but a natural effect cauſed by a volcanic eruption.

The ſtream of lava probably carried along in its courſe the aforeſaid body of copper that had formed into one collection, as faſt as it was heated enough to run, from all parts of the mine. The united maſs was probably borne, in this manner, to the place where it now reſts in the ſoil.

The cryſtallized form, obſervable every where on the original ſurface of the metal that has been left untouched or undiſturbed, leads me to preſume that the fuſion it has ſuſtained was by a proceſs of nature ; ſince this cryſtallized ſurface can only be ſuppoſed to have been produced by a ſlow and gradual cooling, whereby the copper aſſumed regular figures as its heat paſſed into other ſubſtances and the metal itſelf lay expoſed to the air.

As to the properties of the copper itſelf, it may be obſerved that its colour is a clear red ; that it is peculiarly qualified for rolling and forging ; and that its excellence is indicated by its reſemblance to the copper uſually employed by the Engliſh for plating.

The dealers in copper call this ſort *Peruvian copper*, to diſtinguiſh it from that of *Sweden*, which is much leſs malleable. The ſpecimen, under conſideration, is incomparably better than Swediſh copper, as well on account of its brilliant colour, as for the fineneſs of its pores, and its extreme ductility.

Notwithſtanding, before it is uſed in manufactures, or for the coining of money, it ought to be melted anew, for the purpoſe of purifying it from ſuch earthy particles as it may contain.

The examination of the North-American copper, in the ſample received from his excellency the miniſter, by the operations of the cupel and the teſt by fire, has proved that it does not contain the ſmalleſt particle of ſilver, gold, or any other metal."

Native Copper is rare in France ; but is very abundant in some parts of the Uralian mountains in *Siberia* ; at Herngrund in Saxony, the Hartz, at Fahlun in Sweden, and near the Copper Mine River within the arctic circle in America. That of Japan and that of Brazil, are said to contain a considerable proportion of gold. Quartz, fluate of lime, carbonate of lime, and sulphate of barytes, usually accompany Native Copper ; the two latter have rarely been met with in Cornwall, and not at all accompanying Native Copper.

SULPHURET OF COPPER.* GLANCE COPPER.

Sulphuret of copper is of a lead or iron grey colour ; it has a shining metallic lustre, and yields easily to the knife. It occurs massive, and crystallized. The form of its primitive crystal is the hexahedral prism, which passes into an obtuse, and also into an acute dodecahedron, with triangular planes ; the crystals in my possession exhibit 83 varieties of form besides 2 or 3 macles : they are all from Cornwall, where the sulphuret of copper has been abundantly found in several mines ; sometimes intermixed with the yellow copper ore, and occasionally accompanied by the succeeding variety; and by spathose iron ore and fluate of lime. It is also found at Llandidno in Caernarvonshire, and at Middleton Tyas, in Yorkshire. It occurs also in Siberia, Sweden, and Saxony; principally, as it is said, in primitive mountains.

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* Found in the red ſand-ſtone formation, near New-York, accompanied with the oxyd and carbonate of copper ; and in the neighbourhood of New Haven and Baltimore. (*Cleaveland and Gibbs.*) Found at the Schuyler mine in Bergen county, (N. J.) In the green-ſtone mountains running north and ſouth, in Connecticut, between the Sound and Simsbury, with native copper and the red oxyd of the ſame. (*Silliman.*)—At Perkiomen in Montgomery county, and near Cheſter in Delaware county, Pennſylvania, (*Conrad and Wiſtar,*) and in ſeveral other places. I have received very fine yellow ſulphuret of copper, from ſome place in the upper country of Georgia.

The crystallized consists of 81 parts of copper, and 19 of sulphur; the massive contains rather less copper, about the same sulphur, with about 2 per cent. of oxide of iron, and 1 of silex.

PURPLE COPPER. BUNTKUPFERERZ.

This mineral is of a tombac brown colour; and has an irridescent tarnish; it occurs massive, capillary, and crystallized: it is found in the cube, mostly with curvilinear faces, passing into the perfect octohedron. It consists of about 70 parts of copper, 19 of sulphur, and 7 of iron. It is generally found in the same countries as the preceding variety, and accompanying it.

GREY COPPER.

Grey copper is mostly of a steel grey colour; it occurs massive and crystallized, and has a brilliant metallic lustre; it is brittle, but is much harder than the sulphuret of copper; it is found in the cube, passing into the regular octohedron, and in the dodecahedron with rhombic planes. I am not aware that it has been analyzed. I possess crystals of it in 26 varieties of form; they are all from Cornwall.

This mineral seems mostly to be confounded with the *Fahlerz* of Werner, Cuivre gris of Haüy, which was formerly considered as a silver ore, and in which copper, iron, antimony, silver, and sulphur, enter into combination; some varieties also yield arsenic: it crystallizes in the form of the regular tetrahedron, variously modified.

Grey Copper is found in Cornwall in the same veins as the two preceding varieties; the Fahlerz, I believe, has not been found there; but has been met with in the silver mines at Beeralston in Devonshire, and in Wales. It is found also in Transylvania, the Hartz, Saxony, &c.

YELLOW COPPER. COPPER PYRITES.

This mineral is of various shades of yellow, and is often irridescently tarnished externally; it occurs massive, stalactitic, and crystallized in the form of the regular tetrahedron, which is its primitive form; its varieties are not numerous. It has a metallic lustre, and yields easily to the knife. It consists of copper united with variable proportions of iron and of sulphur: in general, the copper does not exceed 20 per cent. It is the most abundant of all the ores of copper, and is the chief ore of the Cornish mines, where it is found in veins, passing through argillaceous schistus and granite. It is met with in Derbyshire, and was abundant in the Ecton mine in Staffordshire in limestone. It is generally accompanied by quartz, iron pyrites, aud sometimes by mispickel and the sulphuret of copper. In the mine called Huel Towan, it was accompanied by spathose iron.

WHITE COPPER.*

White Copper seems to be a variety of the preceding species, distinguished by its being of a silvery white or pale brass yellow colour, and by its affording an arsenical odour before the blow-pipe; its whiteness may perhaps be attributed to the arsenic it contains: it has not been analyzed. It is not common, but occasionally accompanies yellow copper; it is said to have been found in the mine called Huel Gorland in Cornwall.

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* At Fairfield, Connecticut, in a compact ore of Copper, whoſe recent fracture is metallic white, which ſoon turns, by expoſure, to a dirty white, and in time acquires a green hue. It contains arſenic. (*Silliman.*)

RUBY COPPER. RED OXIDE OF COPPER.†

This beautiful mineral is of a fine crimson red colour, and is frequently translucent; but externally, is mostly tarnished, sometimes of a metallic grey colour; it yields easily to the knife, and is brittle; it occurs massive, and crystallized in the regular octohedron, which passes into an acute rhomboid, the cube, and the dodecahedron with rhombic planes: the crystals in my possession are very numerous and exhibit about 70 varieties of form; all of them are from Cornwall. The specific gravity of the red oxide of copper is 3.9; it consists of 91 copper and 9 of oxygen. A variety of the red oxide of copper, is met with in fine capillary crystals which are lengthened cubes; another of a red or reddish brown colour, compact, and with an earthy fracture, is called *Tile ore.*

This mineral is found at Moldava in Hungary; near Cologne; in the eastern part of tne Uralian mountains in Siberia, accompanied by the variety of green carbonate of copper called Malachite; and has been met with in several mines in Cornwall, and in considerable abundance in those called Huel Unity and Huel Gorland, which are situated both in granite and argillaceous schistus; the vein was principally occupied by a brown ferruginous friable substance, called gossan by the miner; in the same vein, but above the red copper, which was generally accompanied by native copper and sometimes black copper, considerable quantities of arseniated copper, and arseniated iron were met with.

BLACK COPPER.

Black copper occurs in a pulverulent form, investing some other of the ores of copper, chiefly the red oxide; it is generally considered to be an oxide of copper, but it gives out sulphureous vapours before the blowpipe.

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† The ſeveral localities of this ore, are in Virginia, on the Fairfax eſtate, near the Shenandoah, (*Hayden*);—in Pennſylvania, near Lancaſter, with malachite;—in the Schuyler Copper mine, near New-York; and in the Connecticut mountains, mentioned in a preceding note.

CARBONATE OF COPPER.*

Carbonate of copper is of various shades of blue and of green. The *Blue* is chiefly of a beautiful azure blue, and is found in small globular masses, massive, earthy, and crystallized; it frequently accompanies the succeeding variety. I possess crystals of it, in about 30 *varieties* of form, but they are not very intelligible; they appear to be principally of that variety which is termed the section of the octohedron; which solid is esteemed to be their primitive form. It is not of abundant occurrence, but has been met with in the mining countries of *Bohemia*, Saxony, the Hartz, Siberia, &c; also in *Cornwall*, and at Wanlock-head, and the Lead hills in Scotland. Some crystals from France very nearly approach the cube, others are rhomboidal, but not determinate.

The *Green* Carbonate of copper, or *Malachite*, is found massive, and in slender prismatic crystals or fibres, which are of a silky lustre, and aggregated in bundles, or stellated; frequently it is almost massive, with a silky fibrous texture. It does not present regular crystals. This beautiful mineral is said occasionally to accompany the greatest part of the other ores of copper. The finest specimens are brought from the Uralian mountains in Siberia: it is also met with in the copper mines of Saxony, Bohemia, the Tyrol, Hungary, &c.; and sometimes, though rarely, in Cornwall. The massive green variety consists of about 58 copper, 12 oxygen, 18 carbonate acid, and 11 of water. The blue variety consists of the same elements, varying somewhat in their respective proportions: and there is a variety of the green carbonate of copper, called *Chrysocolla*, which consists of the same substances in smaller proportions, together with about 26 per cent. of silex; it is of various shades of green and brown, and of very different degrees of hardness; it presents, when broken, a conchoidal fracture, and a resinous shining lustre. It is found accompanying the foregoing varieties; and has been met with in Cornwall, and in the vale of Newlands, near Keswick in Cumberland.

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* Both the mountain blue and mountain green forms of copper exiſt ſparingly, but with diſtinct characters, at Perkiomen, Bergen, Cheſhire, and, it is believed, in ſome other places.

The *Turquoise*, so called because it was first brought from Turkey, is said to consist of the bone or tooth of an animal in the fossil state, penetrated by blue or green carbonate of copper. It is also brought from Persia.

EMERALD COPPER. DIOPTASE.

The Dioptase is of an emerald-green colour; and is met with crystallized only in the dodecahedron, the primitive form of which is an obtuse rhomboid. It is an extremely rare mineral, having only been found in a vein in Daouria, on the Chinese and Russian frontiers; it was accompanied by malachite copper. It is composed of about 29 parts of oxide of copper, 43 of carbonate of lime, and 28 of silex. The portion from which the analysis was made, was only four grains.

SULPHATE OF COPPER.

Sulphate of copper is of a blue colour, sometimes bluish green, and is generally translucent. It has a nauseous, bitter, metallic taste; and is found massive, stalactitical or pulverulent, in certain copper mines, but it is not a common substance. It has been met with in the Parys mine in Anglesea: and in various countries, in crystals of eleven varieties of form, of which the primitive is considered to be an oblique-angled parallelopiped. It consists of copper mineralized by the sulphuric acid.

MURIATE OF COPPER.

This rare mineral is of various shades of green, and is met with in extremely minute octohedral crystals, either loose, in the form of a green sand, in Peru, or investing a dark ochreous quartz, at Remolinos in Chili. The crystals in my possession exhibit 13 varieties of form; the primitive, which is a cuneiform octohedron, and seven of the most simple varieties, were discovered among the green sand of Peru: the remainder are from Chili. The latter consists of 73 per cent. of oxide of copper, 10.1 of muriatic acid, and 16.9 of water.

PHOSPHATE OF COPPER.

Phosphate of copper is externally of a greyish black, internally between emerald and verdigris green; it occurs in small rhomboids with curvilinear faces; also massive, or disseminated in an opake quartz. It is a rare mineral, having only been found at Rheimbreidbach near Cologne, and at Finneberg, and at Nassau-risingen. It is sometimes mingled with arseniated copper, and accompanied by carbonate of lead: it consists of about 68 parts of oxide of copper, and 31 of phosphoric acid.

ARSENIATE OF COPPER.

Of this mineral there are several varieties.

It occurs in very *flat octohedral crystals*, which are of a grass green, deep blue, or bluish white colour; and are sometimes slightly transparent, with a vitreous lustre: this variety consists of 49 oxide of copper, 14 arsenic acid, and 35 water.

Another variety occurs in *six-sided tabular crystals*, which are transparent, and of an emerald green colour, or occasionally, though rarely, white and opake. The sides of the crystals alternately incline different ways, and are generally striated: but I possess some crystals much thicker than they are commonly found, of which the six sides are not striated but very brilliant. All the tabular crystals of this variety, ought, as I conceive, to be considered as sections of an octohedron; in this opinion I am the more confirmed, because I also possess some crystals on which the solid angles of the octohedron are replaced by planes; others on which the edges are replaced; and again others, on which the planes of both these modifications are combined: none of these crystals have heretofore been described.

Another variety, by some called the *triedral arseniate*, is of a very beautiful bluish green, or deep verdigris colour, and transparent; but as their surface is often decomposed and black, the crystals are then opake; their form is an octohedron, which is generally elongated, and their summits are sometimes deeply replaced, giving them the appearance of six-sided prisms with diedral summits; in others, two of the four lateral edges are also deeply replaced, the crystals then assume the appearance of four-sided prisms with diedral summits. The crystals of this variety also assume the form of the tetrahedron, and of a very acute rhomboid, sometimes perfect, sometimes passing into the octohedron; they have been said to occur also in the rare form of the triedral prism, but as the acute rhomboids are often placed on the gangue on one of their extremities, having the other, which if perfect would appear as an acute apex, deeply replaced by a regular triangular plane, I conceive this appearance has given rise to the opinion that the crystals assume the form of triedral prism.

The preceding varieties differ in their respective proportions of oxide of copper, arsenic acid, and water, from the first variety: in the succeeding variety there is no water.

This variety occurs in *slightly acute octohedrons*, which are usually of a bottle green colour; sometimes brown, or nearly black, and somewhat transparent. These crystals are mostly elongated; in some of them, the summits of the octohedron are replaced, as well as two of the four lateral edges; and as these crystals are generally long, they assume the appearance of four, six, or eight-sided prisms, having diedral summits, whence this variety has been termed the *prismatic arseniate*. It sometimes exhibits capillary crystals of indeterminate forms; and others which are regular for some length, but fibrous at the extremity.

The two following varieties agree in their respective proportions of oxide of copper, arsenic acid, and water, but differ from the two first varieties.

One of them, which is of various shades of green, brown, yellow, and white, is of a fine diverging fibrous structure, and a silky lustre; it is called the *Hæmatitic arseniate* of copper.

The other occurs in extremely minute, flexible fibres, occasionally so small as to have the appearance of dust; they are of various shades of blue, green, brown, yellow, and white; and possess a silky lustre. It is called the *Amianthiform arseniate.*

Martial Arseniate of Copper, which, until lately, has been termed *Cupreous Arseniate of Iron*, is of a pale bluish green colour, and occurs in small four, six, or eight-sided prisms, with tetrahedral summits, generally grouped in small globular radiated masses; they are transparent, and have a shining vitreous lustre.

All the above varieties of the arseniate of copper were found in the same veins which produced the red oxide of copper, in the mines called Huel Gorland and Huel Unity, which adjoin each other in Cornwall; their veins pass through both granite and argillaceous schistus.

GOLD.

The specific gravity of Gold, when pure and beaten, is about 19; it is very soft, and perfectly ductile and flexible. So great is its tenacity, that a piece one-tenth of an inch in diameter, will hold five hundred pounds without breaking; and it is computed that a single grain of gold will cover the space of fifty-six square inches, when beaten out to its greatest extent.

Gold is always found in the metallic form, whence by the mineralogists it is said to occur in the native or pure state; but it is generally alloyed by small portions of other metals, as silver, copper, &c.

The uses of gold are well known. Alloyed by copper, it is employed for ornamental purposes, coin and plate.

In English coin it was alloyed by two parts of copper, to twenty-two of gold. The alloy of gold used in plate was formerly the same as the coin: it is now 18 carats, or $\frac{18}{24}$ths gold. The purple colour used in porcelain painting is obtained from a preparation of gold.

NATIVE GOLD.*

Native Gold is yellow, orange yellow, or greyish yellow, with a shining metallic lustre; it occurs crystallized, capillary, ramified, and in masses of various sizes, from the weight of very minute portions to that of several pounds; it is soft, inelastic, flexible, and malleable. It is rarely perfectly pure, but mostly contains small por-

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* The grand ſpecimen of Native Gold, which was examined by me in 1800, at New-York, on its way from the Viceroy of Mexico to the King of Spain was connected with quartz. Both the metal and the rock were amorphous, and exhibited no ſign of cryſtallization. It ſeemed to be a looſe nodule, rounded by rolling; and weighed forty-ſix ounces. The colour of the gold was a fine yellow, with a hue in one part of whitiſh, and in the other of greeniſh. The quartz was white, with a duſky tinge. (*Med. Repos. Vol.* 4, *p.* 201—202.)

Meadow Creek, a branch of Rocky River, a principal ſtream of the Pedee, in Cabarrus county, North Carolina, is more remarkable than any region of the Fredonian States, for native gold. About the year 1803, grains and lumps to the amount of fifteen thouſand dollars were gathered. The firſt piece was found by a boy, who was exerciſing himſelf in ſhooting ſmall fiſhes with a bow and arrows. The maſſes were of different weight from gold-duſt to the unparalelled bulk of a lump of nearly twenty-eight pounds. The heavieſt of theſe natural ſpecimens, loſt only 15 per cent. on being melted and refined. The ſmaller and lighter of them loſe only from 2 to 5 per cent. The grains of gold are found ſcattered among the ſand.

The rocks are of the primitive formation, and the gold is diſſeminated among their ruins.

The ſpecimen which I received from Governor Alexander, is of a rich and beautiful yellow, and is blended with particles of white quartz. (*Med. Repos. Vol.* 7, *p.* 307.) The director of the mint reported, that during 1804, about eleven thouſand dollars of the golden money coined there, was from the gold of North Carolina.

For a year or more after the firſt diſcovery, pieces were occaſionally found of four and five pounds weight, and a great number of the ſize of ſmall grains; and the laſt I heard of this gold-finding buſineſs was, that quickſilver had been employed by the workers, for ſeparating the minute particles of gold from the ſand. (*Ibid. Vol.* 8, *p.* 439—440.)

The ſands of Long creek, about eighteen miles from Meadow creek, have alſo afforded gold duſt. Whenever the maize and cotton are weeded, and the buſineſs of the plantation is in advance, the proprietors have been in the habit of taking their labourers to the ſtream, and of waſhing and ſearching for gold. By conducting the undertaking in this manner, it was found, that it not only paid wages, but afforded a profit. Experience has proved that a buſhel of the ſand, would often afford gold to tions of other metals; as of silver, copper, &c. It occurs crystallized in the form of the cube and octohedron, but as its crystals do not admit of regular fracture, their structure is not sufficiently known to enable mineralogists to decide which of those two solids is the form of its primitive crystal. I possess crystals exhibiting 21 varieties of form, besides 12 others in that compound species of crystallization, expressed by the term macle; each consisting of equal portions of the octohedron united together.

Gold is sometimes combined in other metalliferous minerals. in various proportions, but is said always to be in the metallic state. An argentiferous variety has yielded by analysis, 36 per cent. of silver; and an auriferous variety of silver (mentioned under that head) 28 per cent. of gold. It is combined with other metals in the ores of tellurium, and not unfrequently forms an ingredient in iron pyrites, which thence is termed auriferous. It is also said to have been occasionally found in certain sulphurets of iron, zinc, lead, and mercury, and in some varieties of copper and of arsenical pyrites.

In veins, gold is found only in primitive mountains, but not in those of the most ancient formation; these veins principally contain quartz, felspar, carbonate of lime, and sulphate of barytes; but the gold is sometimes accompanied by sulphuret of iron, of silver, and of lead, and occasionally red silver, manganese, grey cobalt, and nickle.

Gold is found in veins; also in rivers, and alluvial matter, in several countries of Europe. From Spain the Phœnicians and Romans are supposed to have drawn their principal riches; it is also found in Germany and

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the value of fifty cents. A lump weighing twenty-ſeven pennyweights, was found in July, 1808. Small pieces of four, ſix, and even fourteen pennyweights, have been alſo found.

The common way of working was, firſt, to pick out all the viſible grains from the auriferous ſand, and to throw the reſidue into a heap; and afterwards, to ſeparate the more minute particles by amalgamation with quickſilver. It has been ſuppoſed that the alluvial ſtratum in which the gold lies, is very extenſive. A maſs weighing a pound was found in Anſon county. (*Med. Repos. Vol.* 12, *p.* 192—193.)

A few years ago, a publication was made, that gold had been found in the ſand of James river, or one of its ſtreams, at Lynchburgh in Virginia, Sweden; and very sparingly in France and Italy. The principal European mines are those of Cremnitz and Chemnitz, in Hungary; which, together with some others of inferior note, annually produce, by estimate, about 2000 pounds weight. Small quantities are also found in alluvial deposits in Switzerland, and in Ireland; the latter of which contains about fifteen per cent. of silver. It is found occasionally in small grains intermixed with tin in some of the stream-works of Cornwall.

In Asia; gold is found in Siberia in veins, and in many of the Asiatic islands in sands.

From the rivers and alluvial deposits of Africa, large quantities were furnished to the ancients.

By far the greater part of the gold now brought into use, is obtained from the rivers of South America; in various parts of which continent, it is also found in veins, and in considerable abundance. In the Vice Royalty of La Plata alone there are 30 gold mines or workings. It is calculated that the annual produce of America is about 30,000 pounds weight.

Helms says, that when a projecting part of one of the highest mountains in Paraguay fell down, about thirty years ago, pieces of gold, weighing from two to fifty pounds each, were found in it.

PLATINA.*

The specific gravity of Platina when pure, is about 23; its colour is between tin-white and iron grey. Its malleability is so considerable that it may be beaten into leaves as thin as tin foil, and its ductility so great, that Dr. Wollaston has succeeded in drawing it into a wire $\frac{1}{18000}$th part of an inch in diameter, which will support about one grain and one-third of a grain without breaking. It possesses considerable elasticity, and in hardness is not much inferior to iron; but is very difficult of fusion. It is only found in the native state.

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* Three hundred pounds of Platina, were offered to me for examination, at New-York, in 1802. It had been brought from Chaco, in Terra Firma, by the way of Jamaica. It conſiſted principally of ſmall grains, ſmooth to the touch, ſomewhat like flax-ſeed, and rather flat than round. The ſize of the grains was conſiderably coarſer than the large raſpings of iron, and they were more varied and irregular in their forms. Some pieces were, however, much larger; and I now poſſeſs one as large as a middling bean. The colour was ſomewhat between ſilver and iron; and the native metal as it lay expoſed to the eye, brought to mind a reſemblance, though by no means an exact one, to filings of ſilver and pow-

Pure Platina in thin plates is very ductile and flexible. Of late it has been formed into mirrors for reflecting telescopes, spoons, crucibles, and some vessels of considerable dimension for the use of the chemist in particular processes.

NATIVE PLATINA.

Native Platina, is between steel-grey and silver-white colour, and is nearly as hard as iron, and malleable, but is infusible. It has hitherto only been found in small flattened grains rarely exceeding the size of a pea; the largest that has been seen is of the size of a pigeon's egg, and was presented by Humboldt to the King of Prussia. Native Platina is much lighter than pure pla-

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der of tin. The grains were leſs angular and ſhining than the former, and not ſo dark and globular as the latter. A portion of iron, ſeemed to be mixed with the platina; for, on applying the magnet, numerous particles of a duſky hue, adhered to it. It appeared alſo, that many pieces of platina, known to be ſuch by their whitiſh complexion, were attracted by the load-ſtone. Pieces of lead-ore in the form of galena, and of iron in the form of pyrites, were mixed with the platina, in the bags. There was alſo a quantity of earth and ſand. The grains of platina were readily capable of extenſion between the anvil and hammer, and ſhowed neither ruſt nor tarniſh. M Carendeffez determined by experiment, that two hundred and eighty-eight grains of this platina, conſiſted of the following ingredients, to wit:

Carbune of iron,	56
Silicious ſand,	12
Magnetical iron,	40
Gold grains or duſt,	1
Platina,	179
	288 grains.

Which is conſiderably more than a third of foreign ingredients. Platina is reckoned to be about ten times as ſcarce as gold. (*Med. Rep. Vol.* 6, *p.* 213—214.)

tina: it has been found in St. Domingo, Brazil, and Peru.

In St. Domingo it is met with in the eastern part of that island, in the sands of a river called Jaki, at the foot of the mountains of Sibao. The grains are somewhat larger than those of Peru, and are accompanied by magnetic iron ore, gold, &c. It has not been analyzed.

In Brazil it is found in the gold mines of that country in small grains of a spongy texture, free from tarnish, and with very little lustre, mixed with grains of gold, and of palladium; perhaps also with the natural alloy of iridium and osmium. It does not contain any of the magnetic iron sand, or of the minute hyacinths, which always accompany the Peruvian ore. It consists of platina alloyed by very minute portions of gold and of palladium.

In Peru, it is only met with in the Rio del Pinto, in the districts of Citara and Novita in the province of Choco, and near Carthagena in New Grenada. It is found in a magnetic iron sand, in which are mixed grains of gold, minute hyacinths, and fossil wood: and it is said that the whole is covered by rounded pieces of basalt enclosing olivine and pyroxene. The grains of platina are small, flattened, and have occasional indentations, the surfaces of which are generally tarnished; but the other parts have a shining metallic lustre. It consists of platina alloyed with small proportions of iron, copper, lead, palladium, iridium, rhodium, and osmium.

The grains of Crude Platina analyzed by Descotils were accompanied by grains of menachanite and of chromate of iron.

RHODIUM.

This metal has hitherto been found only alloying the native platina of Peru. When pure, Rhodium has a bright metallic surface, but is not malleable; its specific gravity is about 11.

IRIDIUM. OSMIUM.

The former of these two metals, when pure, is white, and perfectly infusible; the latter is of a dark grey or blue colour. They occur, alloying native platina in very small proportion; and likewise together, forming a natural alloy of the two metals.

ALLOY OF IRIDIUM AND OSMIUM.

This natural alloy is found accompanying native platina, in the form of very small, irregular, and flattened grains, which have a shining metallic lustre, but are of a somewhat paler colour than native platina, and are harder and heavier; their specific gravity being 19.5: they possess a lamellar structure, and are brittle.

PALLADIUM.*

The specific gravity of Palladium, when pure, is about 11. In colour, it greatly resembles platina; in thin laminæ it is very flexible, but not very elastic; it is somewhat harder than bar-iron, and is very malleable.

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* Palladium has been diſcovered in an alloy with Brazillian gold, by Joſeph Cloud, Eſq. of the U. S. mint. He is ſatisfied that Palladium has a

It occurs, together with some other metals, alloying, in small proportion, the native platina of Brazil: and also in the native state.

NATIVE PALLADIUM.

Native Palladium occurs in grains apparently composed of diverging fibres; in other respects these grains differ little in external character from those of the native platina, amongst which they are found. Native palladium is infusible; its specific gravity is 11.8; and it consists of palladium, alloyed by minute portions of platina and iridium.

TELLURIUM.

Tellurium, when pure, is about the colour of tin; it is brittle, and nearly as fusible as lead; its specific gravity is little more than 6.

It is an extremely rare metal, and is found only in the metallic state; but is always alloyed, though in very different proportions, by other metals. Its ores are few and rare.

NATIVE TELLURIUM.

Native tellurium is of a tin white colour, and has a metallic lustre: it occurs in small grains, which are brittle, and yield to the knife. It very much resembles grey antimony. It is found in the veins of a transition mountain of compact carbonate of lime, at Fazebay in

real exiſtence; that it is one of the pure, or unoxydable metals; and in this reſpect, on a par with gold, ſilver, and platina. He found it in a native conbination with gold, without the preſence of Platina, or any other metal. (*Amer. Phil. Trans. Vol.* 6, *and Med. Repos. Vol.* 14, *p.* 69—73.)

Transylvania; and also at Beresof in Siberia. It consists of 92.55 parts of tellurium, 7.2 of iron, and 0.25 of gold. Its specific gravity is about 6. It is procured for the sake of the gold it contains, though so small in quantity.

GRAPHIC TELLURIUM. AURUM GRAPHICUM.

This mineral is of a steel grey colour, with a splendent metallic lustre; and occurs in small flat six-sided prisms, with or without four-sided summits; the crystals are generally disposed in rows on the surface of quartz, and are so arranged as to give the appearance of certain characters; whence its name: it is also sometimes found in granular masses; it yields easily to the knife, and is brittle.

It is met with only at Offenbanya in Transylvania, together with sulphuret of zinc, pyrites, grey copper, &c. in veins which traverse a porphyritic mountain. Its specific gravity is 5.7; and it is composed of 60 parts of tellurium, 30 of gold, and 10 of silver.

PLUMBIFEROUS TELLURIUM.

This substance is either yellow or black. The yellow variety occurs in grains and in minute flat four-sided prisms, of a bright metallic lustre; it is somewhat flexible, and soft. It consists of 44.75 parts of tellurium, 26.75 of gold, 19.5 of lead, 8.5 of silver, and 0.5 of sulphur.

The Black is found in irregular shapes, or in lengthened and six-sided plates of a shining metallic lustre. It consists of 32.2 of tellurium, 54 of lead, 9 of gold, 1.3 of copper, 3 of sulphur, and 0.5 of silver.

This variety, which is much heavier than the former, is only found at Nagyag in Transylvania, and is procured as an ore of gold; it is accompanied principally by the same substances as the former variety.

ANTIMONY.*

Antimony is a compact, brittle, bluish white metal, whose specific gravity is between 6 and 7 ; it is found nearly pure.

The ores of antimony are only five in number ; all of which have not been analyzed. In some of them, it is found combined with oxide of iron, arsenic, silex, sulphur, and oxygen.

Antimony is found both in primitive and secondary countries. It forms alloys with other metals, and is used in the arts. It enters largely into the composition of printing types ; it is also used in medicine.

NATIVE ANTIMONY.

This substance is found of irregular shapes ; never crystallized regularly. It occurs at Sahlberg in Sweden in calcareous spar ; at Allemont in Dauphiné, in white quartz ; at Andreasburg in the Hartz, in quartz and sparthose iron ore.

The form of its primitive crystal in the regular octohedron.

It consists of 98 parts of antimony, the rest being silver and iron ; but some specimens, on being exposed to heat, give out a garlicky odour, indicating the presence of arsenic.

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* This metal does not appear to exiſt in great quantity in the Frediſh dominions. A ſpecimen which I once announced, on the authority of Dr. D. B. Warden, as having been found at Saugherties in Ulſter county, N. Y. turned out to be European ; it having got by miſtake, among ſome American minerals, at Paris.

Another ſpecimen ſent me from Maine, could certainly not have been native ; for it bore the plaineſt marks of fuſion, and was undoubtedly an imported ſulphuret of antimony. Still, it is affirmed upon the moſt respectable authority, that Harwinton in Connecticut, affords broad plated native antimony, aſſociated with ſulphuretted antimony, (*Silliman*) ; and that Maine, Maſſachuſetts, Virginia and Louiſiana, have each furniſhed ſamples. (*Cleaveland*)

GREY ANTIMONY. SULPHURET OF ANTIMONY.

Grey antimony is of a light lead grey colour externally, but presents, when fractured, a brilliant metallic lustre; it is occasionally lamellar, fibrous, and is often crystallized: it is extremely brittle, and so fusible, that it readily melts in the flame of a candle: when in minute capillary crystals, it is termed *plumose antimony*.

The form of its primitive crystal has not been ascertained. It occurs in oblique four-sided prisms, terminated by four-sided pyramids; the crystals in my possession exhibit 14 varieties of form. It consists of 75 parts of antimony, and 25 of sulphur.

It is found in Saxony, Hungary, and France; also in Cornwall and Dumfrieshire. It is mostly met with in micaceous schistus, or clay porphyry, mixed with oxide of iron; and is accompanied by quartz and spathose iron ore; in Hungary by sulphate of barytes, sometimes calcareous spar, fluor spar, and chalcedony. It is remarkable that in Cornwall it is only met with in veins in a direction contrary to that of the copper and tin veins, which they pass through.

RED ANTIMONY.

This mineral is brownish, bluish, or reddish externally; and is principally found in minute diverging crystals, which are brittle.

It often accompanies the preceding varieties, and is met with in Hungary, Saxony, in Dauphiné, but principally in Tuscany. It consists of about 67.5 parts of antimony, 10.8 of oxygen, and 19.7 of sulphur.

WHITE ANTIMONY. OXIDE OF ANTIMONY.

White antimony is of a white, yellowish white, or grey colour; it is rarely found in mass, but mostly in slender diverging crystals, which are very tender, heavy, and translucent.

It is a rare mineral; at Allemont in France it is found on native antimony. In Bohemia, on sulphuret of lead. In Saxony, Hungary, and Spain, it is met with investing sulphuret of antimony. It consists of 86 parts of antimony, 8 parts of silex, and 3 of oxide of antimony and oxide of iron.

ANTIMONIAL OCHRE.

Antimonial ochre has been found at Endellion in Cornwall, in Saxony, and Bohemia, upon some of the ores of antimony; it is earthy, of a yellowish or brown colour, and is extremely rare.

LEAD.

Lead is of a bluish grey colour, and is malleable, ductile, inelastic, and very soft; it has never been found in the pure or native state: its specific gravity is between 11 and 12.

The ores of lead are numerous; they appear under very different circumstances and aspects, and present a considerable diversity of combination. Lead is found mineralized, mostly in the state of an oxide, by sulphur and by the carbonic, muriatic, phosphoric, arsenic, molybdic, and chromic acids, and by oxygen: it is also found in combination with the metals antimony, iron, manganese, and silver, or their ores; with the earths, silex, alumine, lime, and magnesia, and with water. Some of the ores of lead, which are very numerous, present combinations of several of these substances; a few of them have a metallic aspect, but several of them have rather the appearance of earthy minerals, being in considerable degree transparent or translucent. The ores of lead chiefly occur in secondary countries; sometimes in the veins of primitive mountains.

It would scarcely be possible to enumerate all the valuable purposes to which lead is applied in the arts, in medicine, and in the common wants of man. Among its less obvious uses, lead is employed to glaze pottery, and its oxide enters into the composition of glass. Four parts of lead and one of antimony form printing types, to which by some is added a little copper or brass. With tin and bismuth it forms alloys, which are used in the arts.

GALENA. SULPHURET OF LEAD.*

Galena has nearly the colour and lustre of pure lead: it is met with crystallized in the form of the cube, which is that of its primitive crystal, and in nine varieties of form; among which is the regular octohedron. It occurs also specular, radiated, granular, and compact. Its specific gravity is 7.5; and it consists of about 85.13 per cent. of lead, 13.6 of sulphur, and 0.5 of oxide of iron; but carbonated lime and silex are found entering into combination in some varieties, in proportions varying between 29 and 38 per cent. Galena is rarely found without some proportion of silver, which varies from $\frac{1}{100}$ or less, to $\frac{1}{12}$. The presence of silver is said considerably to diminish the lustre of the Galena, and it is also said that it is much more frequently found in the octohedral, than in the cubical varieties.

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* The Sulphuret of Lead is found in many parts of the United States. In New-York, in Ulſter, Ducheſs, Renſſalaer, and Geneſſee counties, ſometimes in limeſtone, ſometimes in quartz, and ſometimes in ſhiſt. An inſtructive catalogue of localities in other States, may be ſeen in Profeſſor Cleaveland's Elementary Treatiſe, p. 513—514.

But the moſt extenſive bodies of Galena, perhaps, on the globe, exiſt in Louiſiana and the region to the northward, on the eaſt ſide of the Miſſiſſippi. It commonly reſts upon carbonate of lime, and is often accompanied by ſulphate of barytes. It frequently exiſts in nodules and detached lumps. When Mr. Moſes Auſtin wrote his report in 1804, there were ten principal mines or openings: Now, it is underſtood, there are many more. They are chiefly in the region ſituated weſt of St. Genevieve and St. Louis. Above two hundred miles up the river Merrimack, valuable lead mines have been diſcovered. Veins of the galena are found beyond the River aux Moiens. After various interruptions, the ſeams of metallic matter appear again above the falls of St. Anthony. Maſſes of it are plentiful, further to the north than the junction of the Ouiſconſin with the Miſſiſſippi. It is ſo abundant that the Tatar natives of the region around the Prairie des Chiens melt the lead, and bring it to the trading houſes as an article of exchange. (*Med. Repos. Vol. 9, p.* 87—88, *and Vol.* 17, *p.* 152.)

The specular variety is sometimes called *Looking Glass* Lead ore, on account of its great brilliancy, and in Derbyshire, *Slikenside;* the radiated variety is said always to contain a portion of antimony. The granular variety is sometimes nearly as fine-grained as steel.

Gelena is almost the only ore of the numerous ores of lead, which is found in sufficient quantity to be wrought for the lead it contains. This substance occurs under great diversity of circumstance; which owing to the importance of the mineral, deserves a slight notice.

In France, in the mine of Pompean, it is accompanied by fossil wood; near Medrin, it traverses nearly perpendicular beds of limestone; near Vienna it occurs in schistus; in Languedoc and the Vosges, in decomposed granite; and in some places, in large veins, passing through primitive mountains.

At Bleyberg in Carinthia, it occurs in beds, alternating with beds of compact carbonate of lime; and in grains disseminated through sandstone, and accompanied by oxide of copper, and brown iron ore.

In Silesia it occurs in veins, and in rounded masses in horizontal beds of ferruginous marl, resting upon thicker beds of compact carbonate of lime, enclosing fossil shells, and asphaltum.

In Spain the most important mines of sulphuret of lead are situated in granite hills, in the province of Jaen, and near the city of Canjagar.

In England, the most important mines are those of Derbyshire, which are principally situated in compact limestone, enclosing shells: the veins of lead ore are sometimes nearly vertical, occasionally horizontal, and they sometimes open into large caverns. In these mountains is found the amygdaloid or toad stone, which interrupts the vertical veins, but not the horizontal veins, or rather beds. The lead ore is accompanied by carbonated lime, sulphate of barytes, (of the variety called cauk) and fluate of lime; occasionally by petroleum and elastic bitumen. It is confidently asserted that when the variety of sulphuret of lead called *Slikenside*, is met with, and by any means disturbed, a terrible explosion ensues, by which considerable masses are detached from the vein: this singular circumstance has not been explained.

This substance is found in almost every mineral district in the known world, and perhaps, next to certain ores of iron, is the most common of metalliferous ores: but it is said not to have been met with in any considerable quantity in the Altaic or Uralian chains of mountains in the northern parts of Asia; nor is it common in Peru.

BLUE LEAD ORE.

Blue Lead Ore has only been found as Zschoppau *in* Saxony, in veins, accompanied by other ores of lead, and with quartz, fluor spar, &c.; it occurs massive, and crystallized in small six-sided prisms, and is of a colour between lead grey and indigo blue, with a slight metallic lustre.

TRIPLE SULPHURET OF LEAD.

This mineral is generally of a dark lead grey colour, and shining metallic lustre; it is mostly crystallized in the form of the cube and its varieties; it yields easily to the knife, and is very brittle. It consists of 50 parts of sulphuret of lead, 30 of sulphuret of antimony, and 20 of sulphuret of copper. It has hitherto only been found in Huel Boys mine in Cornwall, in a north and south vein passing through argillaceous schistus, and accompanied by sulphuret of zinc; but some minerals very nearly approximating to this substance in composition have been met with in other countries.

NATIVE MINIUM.

Native Minium is believed to be a pure oxide of lead, which does not appear to have been ascertained by analysis. Its ordinary colour is scarlet, but it is also met with of various shades of grey, yellow, and brown; it occurs of indeterminate shapes, and pulverulent; the latter variety is found in small beds, alternating with clay and sulphuret of lead. It occurs in several places in Saxony, Germany, and France; also at Grassington Moor, in Craven; and at Grasshill Chapel in Yorkshire.

CARBONATE OF LEAD.*

This beautiful mineral is white, or of various shades of grey and brown, and of a resinous lustre. It occurs crystallized, acicular, and fibrous. The crystals are translucent or transparent; the acicular and fibrous mostly opake: it yields easily to the knife, is brittle, and possesses double refraction in a high degree. The primitive form is a rectangular octohedron; its crystals are found in 12 varieties of form. The specific gravity of Carbonate of Lead is 6.7; and it consists of 77 per cent. of lead, 5 of oxygen, 16 of carbonic acid, and about 2 of water. The Carbonate of lead is not very abundant; it is not found in large masses, and is always accompanied by other ores of lead. It is met with in Languedoc and Brittany, in France; in the Hartz; in the lead hills in Scotland; at Alston Moor in Cumberland; in Durham; and occasionally in Cornwall, but principally of the acicular variety.

Sometimes this substance is tinged of a green colour on the surface, by the carbonate of copper; occasionally it is of a metallic lead grey, exhibiting the partial conversion of the carbonate into sulphuret of lead: and at Grassfield mine near Nent-Head in Durham, carbonate of Lead is found abundantly of an earthy texture, and of a grey colour; but is tinged sometimes greenish, yellowish, or reddish: it occurs massive, or granular, and is very heavy.

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* This beautiful white ore of lead is found near Abingdon in Virginia. It occurs in lumps or maſſes of ſlender, and ſometimes radiating cryſtals. In the box of cryſtals which I received from the proprietor, Mr. Sheffey, were contained, beſides the white ore, maſſes of galena, and amorphous lumps of a yellowiſh colour, like ochre.

Found alſo at Perkiomen and Coneſtoga. (*Conrad.*)

MURIATE OF LEAD.[*]

Muriate of Lead is of a greenish yellow colour, and is found crystallized in quadrangular prisms, which are sometimes terminated by pyramids; it is soft and somewhat transparent, and consists of 85.5 of oxide of lead; 8.5 of muriatic acid, and 6 of carbonic acid. It is found at Cromford Level near Matlock, and in the mountains of Bavaria.

PHOSPHATE OF LEAD.[†]

Phosphate of Lead is of various shades of green, yellow, and yellowish brown; but when reduced to powder is always of a grey colour. It is found principally in six-sided prisms, sometimes having six-sided pyramids, but does not afford many varieties of form; it is divisible into an obtuse rhomboid, which therefore is considered to be its primitive crystal. Its crystals are generally somewhat translucent, possess a resinous lustre, and are brittle. The green phosphate of lead consists of 80 parts of oxide of lead, 18 of phosphoric acid, and nearly 2 of muriatic acid.

The brown variety contains about 2 per cent. more of the phosphoric acid, and 2 per cent. less of the oxide of lead. A variety is found at Johngeorgenstadt in Saxony, consisting of about 77 parts of oxide of lead, 9 of phosphoric acid, and 4 of arsenic acid, the rest being water.

The Phosphate of Lead occurs in veins in primitive and secondary mountains; it sometimes accompanies sulphuret of lead, carbonate of lead, iron ochre, quartz, sulphate of barytes, and carbonate of lime. The green phosphate occurs at Alston Moor in Cumberland, at Allonhead, Grasshill, and Teesdale in Durham; at Nithisdale in Yorkshire; and at Wanlockhead in Scotland.

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[*] A carbonated muriate of lead of a cubic form with tetrahedral cryſtals, occurs in the lead mine of Southampton, Maſſachuſetts, among the galena. The cryſtals are nearly transparent, of a very light green, and ſituated in cluſters, (*Meade.*)

[†] Found at Perkiomen, Weſtar and Southampton, among the other forms of lead.

SULPHATE OF LEAD.*

This substance mostly occurs in translucent crystals, which are colourless, or of a smoke or yellowish grey colour. The form of the primitive crystal is a rectangular octohedron; the crystals in my possession exhibit 30 varieties of form; they are all from Cornwall. Sulphate of Lead is composed of about 71 parts of oxide of lead, 24.8 of sulphuric acid, 2 of water, and 1 of oxide of iron. It has been found in Andalusia in Spain; at Wanlockhead and the Lead hills in Scotland; but principally in the Parys mine in Anglesea. In Cornwall, it was met with in a copper vein in a mine called Velenoweth, very near the surface, and was accompanied by the sulphuret of lead; it occured in an ochreous brittle substance, termed by the miner Gossen.

ARSENIATE OF LEAD.

The arseniate of Lead occurs principally in slender six-sided crystals, which sometimes are fasciculated; or in fibres, of various shades of yellow, sometimes with a tinge of green; they are generally translucent, and have a resinous lustre. The specific gravity of Arseniate of Lead is about 6; it consists of 69.76 per cent. of oxide of lead, 26.4 of arsenic acid, and 1.58 of muriatic acid. In France, it has been met with in a lead mine, accompanied by quartz, fluate of lime, and sulphuret of lead. In Andalusia, in felspar, with quartz and galena; and in Huel Unity mine in Cornwall, in a copper vein situate in granite.

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* Found in the Southampton mine in plates or tables, upon the cubes of galena, and ſometimes in the cavities of the quartzy matrix. Colour white, with a ſtrong glaſſy luſtre. (*Meade.*)

MOLYBDATE OF LEAD.*

The Molybdate of Lead is met with principally in crystals of various shades of yellow, having a glistening resinous lustre; it is soft, brittle, and somewhat translucent. The primitive crystal is an octohedron, with similar and equal isosceles triangular planes. The crystals in my possession exhibit 35 varieties of form. The specific gravity of Molybdate of Lead is about 5; and it consists of 58.4 parts of oxide of lead, 38 of molybdic acid, and 2.08 of oxide of iron. It was first discovered at Bleyberg in Carinthia, upon a compact *lime*-stone; and has been since found at Zimapan in Mexico, on the same substance. It occurs also near Freyberg and at Annaberg in Saxony, and at Felsobanya in Hungary.

CHROMATE OF LEAD.

This beautiful substance is of an orange red colour; it has mostly been met with crystallized: the primitive form of its crystals is an oblique four-sided prism; the varieties it assumes are very few. It consists of 64 parts of oxide of lead, and 36 of chromic acid. This mineral is extremely rare; it was found in the gold mine of Beresof, in the Uralian mountains in Siberia, upon a quartzose gangue containing oxide of lead and oxide of antimony, which occurred in a vein containing sulphuret of lead, parallel with another containing decomposed auriferous pyrites. These veins are situated in gneiss and micaceous schistus. Pallas mentions having also discovered this mineral 15 leagues higher north, disseminated in beds of clay, and dispersed on beds of sandstone, alternating with each other, and accompanied by cubic crystals of auriferous pyrites.

This substance is said to be occasionally accompanied by small acicular crystals of a green colour, which are considered to consist of oxide of lead and oxide of chrome, but have not been analyzed.

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* Found at Perkiomen, cryſtallized in ſmall quadrangular tables with bevelled edges. (*Conrad*) At Southampton, in ſmall tabular cryſtals of a dark waxen colour. (*Meade.*)

ZINC.

Zinc is a bluish grey metal; its tenacity is not great; a piece one-tenth of an inch in diameter will hold twenty-six pounds without breaking; and being far less ductile than some other metals, its importance is thereby diminished. Its specific gravity is about 7.

Zinc is never found in the pure metallic state, but mineralized by sulphur, oxygen, the carbonic or the sulphuric acids; and combined with oxide of iron, silex, and with water. All the varieties of its ores may be said to be comprehended in the four following species, most of which have the appearance rather of earthy than of metalliferous substances; they belong chiefly to secondary countries.

Zinc is employed by the Chinese for coins: it enters into the composition of many alloys. It is sometimes used in medicine, and in oil painting.

BLENDE. SULPHURET OF ZINC.*

Blende is met with of various shades of yellow, brown, and black; it occurs of indeterminate shapes, massive and crystallized; it yields easily to the knife, and is brittle.

The form of the primitive crystal of Blende, into which the compact variety is readily reduced by cleavage, is the rhomboidal dodecahedron; but the varieties of form assumed by its crystals are very numerous, though not very intelligible, except such as are obviously allied to the tetrahedron, octohedron and the cube.

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* The Sulphuret of *Zinc* frequently accompanies the Sulphuret of Lead; as at the Rocheſter mine in Ulſter county, N. Y.; in that near Baltimore; at Perkiomen; and Southampton.

Blende of different colours, is found in ſeveral other places; its importance is derived more from its fitneſs for mineralogical cabinets, than its value as an ore fit for working.

The massive variety of a brown colour, affords 50 parts of zinc, 12 of iron, and about 29 of sulphur; some varieties are phosphorescent by friction.

Blende is found in most mineral countries, especially in beds in the older secondary. It is met with in metalliferous veins traversing primitive mountains, principally in those containing copper and lead; it often accompanies, or is accompanied by, iron pyrites, native silver, grey antimony, spathose iron, sulphate of barytes, calcareous spar, and quartz. It is very abundant in many of the copper and tin veins of Cornwall, especially the former, and at a small depth beneath the surface. Some of the blendes of Hungary and Transylvania are auriferous.

CALAMINE. CARBONATE OF ZINC.

This substance is found earthy, compact, and crystallized; it yields easily to the knife, and has remarkably the appearance of an earthy or stony substance.

The form of its primitive crystal is an obtuse rhomboid. It does not assume many varieties of form: but is often found investing crystals of carbonated lime; which, in some instances, being decomposed, leave the calamine in the forms they had assumed.

It is chiefly found accompanying sulphuret of lead, in shell limestone; and is particularly abundant in the Mendip hills in Somersetshire; at Holywell and other places in Flintshire; in Derbyshire; and in Carinthia, &c. In France, near Juliers, it forms very extensive beds, and is accompanied by certain ores of lead and iron.

It yields about 65 per cent. of oxide of zinc, and 35 of carbonic acid; a variety is found in the Rutland mine at Matlock, which is combined with carbonate of copper.

ELECTRIC CALAMINE.

The name of this mineral is derived from its property of becoming electric when gently heated. Its colour is greyish, bluish, or yellowish white; it is found in mass, and also crystallized in small flat hexahedral prisms, which are harder than common calamine.

It is found in Hungary, at Fribourg; and in Leicestershire, Flintshire, and at Wanlockhead. It differs from the other ores of zinc in always containing a considerable proportion of silex. The variety from Wanlockhead yields 66 of oxide of zinc, and 33 of silex.

SULPHATE OF ZINC.

This mineral is a white, limpid, soluble salt, and is by some mineralogists ranked amongst saline minerals; it has a nauseous metallic taste, and is found filamentous, massive, and stalactitical.

In the natural state it is rare, and chiefly occurs in capillary efflorescences, or in stalactites, on the sides of the workings in veins of sulphuret of zinc. It is thus occasionally seen at Ramelsberg in Switzerland, at Idria in Carniola, and at Schemnitz in Hungary. It also occurs at Holywell in Flintshire. That of Ramelsberg yields by analysis about 27 parts of oxide of zinc, 22 of sulphuric acid, 50 of water, and a trace of oxide of manganese.

RED OXIDE OF ZINC.

This mineral was brought to me as long ago as the year 1799, by a perſon from New-Jerſey, who ſaid it contained zinc. He wiſhed me to make experiments upon it; but I did not find opportunity or inclination to analize it. I however gave ſpecimens freely to my mineralogical friends; and among others, to Dr. Bruce.

It occurs among the iron ores of Suſſex county; and is indeed the cement or matrix which connects the grains of various figures and magnitudes of an oxyd of iron that is cryſtallized, though more commonly irregular. It is found imbedded in calcareous ſpar. Now and then, the oxyd of zinc is whitiſh, adhering to the black oxyd of iron.

It conſiſts of	Zinc	76 parts.
	Oxygen	16
	Oxides of manganeſe and iron	8
		100

Its colour is light and dark red, approaching to blood red, ruby and aurora red. It is opaque, though generally tranſlucent on the edges. Its fracture foliated; croſs-fracture ſlightly conchoidal. Luſtre on the freſh fracture, ſhining; after long expoſure to the atmoſphere, dull; the ſurface in time becoming covered with a pearly-white cruſt. Conſtitution brittle, eaſy to be powdered, and the powder browniſh-yellow, approaching to orange. Steel ſcratches it eaſily. Its ſpecific gravity is 6.22. (*Amer. Min. Jour. p.* 96—97.)

A very curious and intereſting queſtion aroſe in Congreſs, when I was, in 1810, a repreſentative from the city of New-York, to the popular branch of that body. It involved the ſubject of zinc, ſpelter, teutenague, and braſs teutenague, as connected with duties on importing them into the United States, from foreign ports. The whole correſpondence and controverſy, are recorded in Med. Repos. Vol. 15, p. 107—112. In my collection of minerals are ſpecimens of each article, as I received them from the Collector of the Cuſtoms at New-York.

" Zinc, is a metal well known to be abſolutely neceſſary in *making* braſs. It is imported from England and the Eaſt-Indies. From the Indies, it is imported under the name of Teutenague, which the ſtatute ſays is free. A metal by this name is not known in mineralogy; how it ſhould have been noticed as free, is a myſtery to thoſe who know that it derived its name from a Spoon-maker, who lived in Birmingham about the year 1730. He made the diſcovery, that tin and a ſmall quantity of regulus of antimony, produced a compound ſomewhat better than tin and lead, which makes pewter. Teutan, proud of the diſcovery, gave it the name of *Teutenague*, or *Teutania*, as it is more generally called. Little did the honeſt ſpoon-maker think he would have been ſo much honoured in our ſtatute. *Lapis calaminaris* is free; this is the ore of zinc; none of which is imported, except a ſmall quantity of the calcine, as a drug. It is well known, that the Britiſh prohibit the exportation of all metals, not manufactured: the ſhippers of zinc, therefore, are neceſſitated to ſhip zinc under the name of ſpelter. Spelter, in fact, is a mixture of fine braſs and zinc granulated, uſed by braſs founders and braziers, to ſolder. The braſs founders in this country, make all they uſe; it is not imported except in ſmall quantities. The only difference between Engliſh and India zinc is about 5 per cent. in favour of the Engliſh, on account of its being leſs droſſy. If the article of zinc is to be admitted as free from duty it ſhould be expreſſed under the name of *Spelter*, or *Zinc*." (*Curtis.*)

QUICKSILVER OR MERCURY.

The liquidity of Mercury at the ordinary temperature of the atmosphere, is a remarkable character, and distinguishes it from all other metals, It is thirteen times heavier than water. It is found pure; and also combined with silver, with sulphur, and with small quantities of silex, oxide of copper, carbon of bitumen; and mineralized in the state of an oxide, by the muriatic and sulphuric acids.

Its ores are not numerous; and being rarely found in primitive rocks, is not considered to be a metal of the newest formation.

The quicksilver mines of Idria, in Saxony, are said to yield 100 tons annually; and those of Spain a still greater quantity. The mines of Peru are by some supposed to be still richer.

The uses of mercury in medicine, in the arts, and in experimental philosophy are numerous; but its chief use is in the separation of gold and silver from their ores, by a process called amalgamation. When amalgamated with tin, and laid on glass, it forms mirrors.

NATIVE QUICKSILVER.

Native Quicksilver is of a silver white colour, and splendent metallic lustre; it occurs disseminated in globules, or collected in the cavities of its mines, which are commonly situated in calcareous rocks, indurated clay, or argillaceous schistus. It is mostly met with in the mines containing the ores of quicksilver. It sometimes contains a little silver.

Quick silver is found in the Palatinate, Saxony, Bohemia, Hungary and Transylvania; and abundantly in Peru.

NATIVE AMALGAM. SILVER AMALGAM.

This mineral is of a silver white, or of a greyish colour, and is sometimes semi-fluid; when compact it is very brittle, which at once distinguishes it from silver: it is mostly tarnished externally. It occurs also in small octohedrons, in rhomboidal dodecahedrons, and in thin laminæ; and is commonly found in a kind of clay, which is of various colours. It consists of 64 of mercury, and 36 of silver. It is a rare mineral, and has principally been met with at Rosenau in Hungary, and at Mærsfeldt and Moschellandsberg in the duchy of Deux-ponts. It is said to be found in veins containing silver, traversing those enclosing quicksilver.

CINNABAR.

Cinnabar is of various shades of red, frequently cochineal red. It is very heavy; it occurs massive, when it is dull and opake; it also occurs of a minutely fibrous structure, with a glimmering silky lustre; also lamellar, of a shining lustre and translucent; and crystallized in the regular hexahedral prism, which is considered to be the form of its primitive crystal; only one variety of form has been noticed. It consists of 81 of mercury, 15 of sulphur, and 4 of iron.

A variety called *Hepatic Cinnabar* is united with small portions of carbon, silex and oxide of copper; and this variety sometimes occurs mixed in various proportions with coarse coal or bituminous shale, and is then called *Bituminous Cinnabar.*

The most abundant European mines of Cinnabar, are those at Idria in Carniola (which principally yield the hepatic variety), and those of Almaden in Spain, which are situated in the independent coal-formation. The ores of Cinnabar are usually accompanied by calcareous spar, spathose iron, micaceous iron, and iron and copper pyrites.

Cinnabar is said to occur sparingly in primitive strata.

HORN QUICKSILVER.

Horn Quicksilver is of a pearl grey colour, sometimes of a greenish yellow; it is soft, translucent, and of a vitreous lustre; it occurs massive; also crystallized in small 4 sided short prismatic crystals, terminated by 4 sided pyramids, and therefore in dodecahedrons; but the planes of the summits are rhombic, the lateral planes are six-sided. It consists of about 76 parts of oxide of mercury, 16 of muriatic acid, and 7 of sulphuric acid. It is found at Almaden in Spain, at Horsowitz in Bohemia, and in the mines of Deux-ponts in the cavities of a ferruginous clay, mingled with malachite and grey copper, &c.

COMBUSTIBLE MINERALS.

Including non-metallic substances, the greater part of which are eminently combustible, and whose bases are carbon and sulphur.

SULPHUR.*

The nature and properties of Sulphur have already been noticed in treating of combustibles generally.

Sulphur is found in the mineral, vegetable and animal kingdoms; in the two latter it occurs so rarely, that all the vaſt commercial demands for it are ſupplied from

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* In the town of Phelps, about eleven miles to the northweſt of Geneva, are ſituated the ſulphureous fountains of Clifton.

From a ſide-hill, in front of the public houſe, numerous ſprings diſcharge their waters. The ſtones and rocks through which they iſſue are calcareous. The main body of them are filled with the remains of teſtaceous animals, and marine exuviæ. Some of them are formed differently from any ſhells I ever ſaw. Their ſhapes are ſo ſingular and fantaſtic, that it is hard to refer ſeveral of them to any known or living ſpecies.—There are likewiſe plentiful depoſites of calcareous carbonate. This lime ſeems to have been held in ſolution by the water, and collects among the ſtones and other bodies where the current is gentle, or approaches to ſtagnation. It is aſſociated with a portion of the ſulphur depoſited by the inflammable air.

The water iſſues in the greateſt quantity from three principal ſources.—It is as abundant as from the moſt plentiful ſprings I ever ſaw. The water, as it comes forth, is perfectly tranſparent. But it ſoon becomes opaque, and of a yellowiſh colour, reſembling a diluted mixture of cream with water. This hue appears, as it deſcends the declivity, and becomes ſtill more manifeſt as it traverſes the meadow, at the foot of the hill.

This yellowiſh matter ſettles on the rocks, ſtones, moſs, and other plants. On being collected, it proves to be brimſtone. It is in a ſtate to be friendly to vegetable life. For though it covers the leaves and ſtems of the aquatic plants, over which the water flows, it ſeems to do them no injury. Though coated with ſulphur, they enjoy entire health. There did not appear any ſign of blackneſs or eroſion from this cauſe, on the blades of graſs which were conſtantly expoſed to it.

The water is equally friendly to the life of animals. Horſes drink it free-the former source. It is found nearly pure; and is then termed Native sulphur. It is also found in combination with several of the metals, forming the various pyrites, and the sulphuretted ores. In the state of an acid, it occurs combined with some of the earths and metals.

ly, and without any inconvenience. Other domeſtic creatures do the ſame, and are refreſhed as much by it, to all appearance, as by common water. Human beings alſo drink it, without any bad effect. In ſome, it excites a little nauſea, eſpecially upon an empty ſtomach. But this ſeems to ariſe from the offenſiveneſs of ſulphur to the ſmell and taſte of ſuch perſons, rather than from any thing deleterious in the water. A fiſherman aſſured me that he had taken trouts with the hook in this ſulphureous brook. And it cannot be well ſuppoſed that there ſhould be any thing very diſagreeable in the water, voluntarily viſited by ſuch delicate and dainty fiſhes. They probably are induced to approach the ſource, for the purpoſe of feeding upon certain ſpecies of worms, (one of which has ſome reſemblance to the leech) which adhere in great numbers to the lower ſides of the ſtones. This water is their reſidence, and the trouts probably enter it to make a prey of them.

The depoſites of calcareous and ſulphureous matters are not the only things which diſtinguiſh theſe ſprings. A great quantity of vapour eſcapes from them. This riſes to a conſiderable height, and may be ſmelled many rods to leeward as you approach. The odour is that of inflammable air holding ſulphur in ſolution. In the ordinary condition of ſulphur, the hydrogen is too ſmall in quantity, relatively to the ſulphur, to riſe with it into the atmoſphere. But when the proportions are reverſed, and the hydrogen is in a very large ratio to the ſulphur, it carries away with itſelf a portion of that material. Upon the ſame principle that an abſolutely large body of inflammable gas can elevate a balloon, a relatively large portion of it can carry up atoms of ſulphur. Theſe are wafted about, and diffuſed through the air.

Though the water, when it firſt riſes from the earth is perfectly clear, yet as was before obſerved, it ſoon becomes turbid. This probably happens in conſequence of the eſcape of the inflammable air, leaving behind that portion of ſulphur which it is unable to carry off: and this diſengaged ſulphur firſt changes the colour of the water, and then ſettles on the leaves, graſs, and ſtones. In conſequence of this copious extrication of gaſeous matters, the water is cold; and it contains ſome ingredient, which is probably a little uncombined ſulphuric acid, which decompoſes ſoap. For on attempting to form a lather with it, curdles were immediately produced.

At a ſhort diſtance, leſs I ſhould think than a quarter of a mile, and on the other ſide of the road, are other ſulphureous oozings. In theſe, the water is ſmall in quantity. The ſulphuretted hydrogen immediately eſcapes: the ſulphur which it does not carry off with it, is left behind.—There being too little water to waſh it away, it accumulates in beds or ſloughs. This is alſo on a ſide-hill: but, notwithſtanding the favourableneſs of the ſituation for carrying away the ſulphur, it has gathered until a ſort of marſh or puddle, of perhaps ten rods in diameter has been formed. Here it lies mixed with mud, leaves, ſticks, and every ingredient that accident has thrown into it. The maſs is ſo conſiderable that it would be eaſy to ſhovel up cart-loads of it; but I did not hear that any attempts had been made to refine, purify, or in any other way to manufacture it.

Native Sulphur is of a pale greenish yellow colour. It occurs in mass, disseminated, in rounded fragments, stalactitic, and crystallized. Its specific gravity is about two.

It is sometimes, though rarely, found in veins in primitive mountains; its common repository is in beds of

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If I was diſpoſed to offer a conjecture concerning the production of this inflammable air, and of the ſulphur which accompanies it, I ſhould derive them from the animal remains which make ſo large a proportion of the calcareous ſtrata hereabout. The rocks at this place, as well as at Niagara, and along the ſhores of Lake Erie, are remarkable for the fetid ſmell they emit, on being rubbed or ſtruck. This leads to a belief that both hydrogen and ſulphur enter into their compoſition. This is further manifeſted by the frequent appearance of them both, where theſe beds of materials are undergoing ſpontaneous decompoſition from internal cauſes. In ſuch caſes, they are evident to the ſenſes in their proper and ſeparate forms. The incruſtations of ſulphur, in the fiſſures of ſome rocks, and the extrication of hydrogen gas from the crevices of others, in this curious and intereſting region, perſuade one ſtrongly, that ſuch is the fact.

How it happened that organic ſubſtances make part of the deep and extenſive ſtrata which underlay this country, may be reſolved into the greater queſtion, by what means ſuch materials enter into the compoſition of rocks in other parts of the world, and in ſituations very remote from the ocean. They lead the mind by indubitable evidence to the time when, in ages too diſtant for the chronologiſt to compute, the waters of the ſea covered the face of the land.

The country lying ſouth of the lakes Ontario and Erie, bears within itſelf full teſtimony of the former dominion of oceanic water there. The ſalt ſprings in Galen, Montezuma, Salina, and other places, may be conceived as proceeding from beds of ſal-gem in the bowels of the earth. And this native ſalt may be conſidered as a depoſite made from the brine of the ſea, ſometime ſince the ſtrata of limeſtone were formed. When the ſalt-water withdrew to the lakes, the upland was gradually freed from its ſalt, here, as in other places, by the rains and the floods. The land being thus freſhened, the ſalt-water collected in the lakes and reſervoirs; and had there been no outlets, they would have been collections of briny fluids ſtill. But as all the lakes of our continent have channels for diſcharging their contents, it has happened in the courſe of aqueous circulation, that the primitive ſaltneſs has diſappeared, and theſe reſervoirs of ſalt-water are now filled with freſh. The lakes of North America have long ſince undergone the freſhening operation which the Black Sea is now undergoing. For it may be predicted that the Euxine, which is now but a brackiſh water, will, in proceſs of time, loſe the whole of its ſaltneſs.

The lakes having undergone this transformation, and ſo altered their character, we look at firſt with ſurprize upon the ſalt and ſhells which are left behind. Theſe, however, are monuments of the former ſtate of things; and when duly conſidered by the light which geology affords, enable us to comprehend many of the facts which would be otherwiſe inexplicable.

My theory, then, of the ſulphureous ſprings at Clifton, is conciſely this: before the water of the ocean retired to the lakes, ſtrata of limeſtone were depoſited, and as parts thereof, vaſt quantities of ſhells, and other remains of teſtaceous and perhaps other animal matter. From theſe, there are extricated in ſome places, hydrogen gas and ſulphur: and water, guſhing secondary gypsum, where it occurs in rounded masses; it is sometimes met with in beds of indurated marl, and compact limestone: occasionally it occurs as an ingredient in mineral waters. Volcanoes abound with sulphur, which sublimes in the rifts and cavities of the lava in the neighbourhood of their craters.

Humbolt mentions its occurrence in a bed of quartz, traversing a primitive mountain of micaceous schistus, in Quito. He also cites two deposites in primitive porphyry.

Sulphur occurs in rounded masses in blue marl in the Apennines of Piedmont. In some of the glaciers of Mont Blanc, it is disseminated in masses of sulphate of lime and clay. At Conilla, near Cadiz in Spain, it occurs in swine-stone. It is met with in the gypsum of

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along, carries with it a portion of the lime. The hydrogen gas ſo ſeparated, is the menſtruum for the ſulphur, and the water for the lime. On coming into the open air, the portions of ſulphur and lime, which the gas and the water cannot any longer retain in ſolution, are precipitated on the adjacent bodies.

I have ſpecimens from Clifton, of the fetid limeſtone, madreporites, and other marine animals, and of recent vegetable ſubſtances, incruſted with Brimſtone. I poſſeſs, likewiſe, pieces of the fetid carbonate of lime, from the falls of Niagara, carrying ſulphur in a layer of the thickneſs of the eighth of an inch.

The ſulphur ſpring, N.W. of Geneva, N. Y. is of ſufficient ſize and fall for an overſhot mill, and its ſcent is conveyed by the wind, nearly the diſtance of two miles. This ſpring iſſues out of the ground in two branches, and adjoining to it are two large bogs of ſulphur, into which a ſtick may be thruſt ſix feet deep or more. It is ſuppoſed, that at this ſpring, the manufacture of brimſtone, might be conſiderably important. (*Munro, Med. Repos. Vol.* 12, *p.* 69—70.)

The ſulphur evolved by the putrefaction of maritime plants and marine animals, ſometimes floats in the form of a yellow ſcum on the ſurface of the pools and ſtagnant ponds of ſalt water, along the coaſt of New-York. As a proof of it, among other evidences, I relate the following occurrence. Being a few years ago, on a trip along the Sound, our party landed upon Riker's iſland. The greater part of the company were amuſing themſelves at the Inn, when I returned from a ſhort excurſion. I brought with me a parcel of the ſulphur I had gathered upon the ſurface of a pond, on a ſalt marſh. Secretly, and without any knowledge on the part of my fellow-voyagers, I threw ſome of the brimſtone into the fire, and brought it forward on the hearth, while it was burning. The vapours, inſtead of aſcending through the chimney, circulated through the room. The conſequence was, an univerſal cry aroſe that a match was lighted, and that ſomebody was ſmoking them with brimſtone.

Very lately, I received ſpecimens of ſulphur, elegantly cryſtallized, from the volcano, nearly extinct, ſituate about ſixty miles from Batavia, in the iſland of Java.

the salt springs of Lorraine. It also occurs in Hanover, Hungary, Poland, Siberia, and other countries.

The warm springs of Aix la Chapelle, of Trivoli, &c. deposite Sulphur when in contact with the air : it is also contained in the waters of certain springs in France.

Volcanic Sulphur is met with in Italy, Iceland, and Gaudaloupe in a volcanic mountain yet in activity. The volcanoes of the Cordilleras in Quito, yield it in great abundance and very pure.

But perhaps the most remarkable deposite of volcanic sulphur is that of Solfatara near Naples, in a kind of sunken plain surrounded by rocks, which is regarded as the crater of an ancient volcano ; and from it, ever since the age of Pliny, has been obtained, a considerable portion of the sulphur used in Europe.

The crystals of sulphur are not always well defined : those from Sicily are the best, being frequently perfect ; they have been met with 5 inches in length. The primitive crystal is a very acute octohedron, on which are occasionally found the planes of several modifications. The crystals are often semi-transparent : they are soft, brittle and easily broken.

DIAMOND.

The Diamond, which is the hardest substance in nature, was heretofore considered as an earthy or stony substance ; but it is proved beyond a doubt not to be an earthy substance. When exposed to a current of air, and heated to the temperature of melting copper, it is found to be gradually, but completely combustible. By this process it may be wholly converted into carbonic acid, and therefore consists of *pure carbon.*

Diamonds are either colourless, or of a yellowish, bluish, yellowish green, clove brown, black brown, Prussian blue, or rose red colour. They are always found in detached crystals, the primitive form of which is the regular octohedron ; but the varieties of form in which they occur are numerous. Although the Diamond is so extremely hard, it may be readily cleaved in particular directions. When heated, it becomes phosphorescent. It possesses only a simple refraction, but this may be attributed greatly to its density, considered as a stone. Newton, in remarking this, suspected that the Diamond ought to be placed among combustibles. It is about 3½ times heavier than water.

In India, the Diamond mines extend through a long tract of country, from Bengal to Cape Comorin, at the foot of a chain of mountains 50 miles in length: the chief of them are now between Golconda and Masulipatam. Diamonds are also procured from the Isle of Borneo and from Brazil; where, as well as in India, they are found in beds of ferruginous sand or gravel.

Fifty years ago there were more than 20 places in the kingdom of Golconda in which diamonds of different sizes were found. At that period, 50 workings were also wrought in the kingdom of Visapour. These mines furnished more diamonds than the others; but being smaller, the workings were abandoned. The Diamonds of Pastael, 20 miles from Golconda, at the foot of the Gate mountains, are the most in request. The mines are situated at the conflux of two rivers; they have produced the most noted diamonds, and amongst them that which has obtained the name of the Pitt or Regent Diamond, the finest of the crown jewels of France, weighing 136 carats, or nearly one ounce, and which was purchased for 2,500,000 livres.

From Mawe's Travels in the Interior of Brazil, we find that the Diamond mines of that country are situated nearly due north of the mouth of the Rio Janeiro. The capital of the district is called Tjuco. The country is covered in all directions by grit-stone rocks, full of rounded quartzose pebbles. The hills are very numerous, and consist of grit alternating with micaceous schistus, and present an immense number of blocks composed of grit-stone imbedding rounded masses of quartz, giving to the whole the appearance of a pudding-stone. The general level of the country must be considerably elevated; it is very full of streams, which fall into the rivers traversing the lower country in almost every direction. Diamonds have been largely obtained in various places in this district, and always from the beds of the streams or rivers; most of which have yielded them. The principal work is that called Mandanga on the river Jigitonhonha: which being shallow, though broad, its waters are either dammed out, or diverted from their course, or pumped out by a particular contrivance. The mud of the river is then removed, discovering a stratum of *cascalhão*, which consists of rounded pebbles and gravel; this is taken up, and the diamonds are washed out of it. Diamonds are by no means peculiar to the beds of rivers or ravines; they have been found in cavities and water courses, on the summits of the most lofty mountains of the district.

A diamond, found about 15 years ago in a rivulet called Abaité, a few leagues north of the Rio Plata, and now in the possession of the Prince Regent of Portugal, weighs seven-eighths of an ounce. It is of an octohedron form.

One of the largest known diamonds was in the possession of the late Empress of Russia; it was of the size of a pigeon's egg and weighed 193 carats or nearly one ounce and one-third of an ounce.

The largest diamond hitherto found, is in the possession of the Rajah of Mattan, in the island of Borneo, in which island it was found about 80 years ago. It is shaped like an egg, with an indented hollow near the smaller end. It is said to be of the finest water. It weighs 367 carats. Now as 156 carats are equal to 1 oz. Troy, it is obvious that this diamond weighs 2 oz. 169.87 gr. Troy. Many years ago the governor of Batavia tried to purchase this diamond. He sent a Mr. Stuvart to the Rajah, who offered 150,000 dollars, two large war brigs with their guns and ammunition, together with a certain number of great guns, and a quantity of powder and shot. The Rajah, however, refused to deprive his family of so valuable an hereditary possession, to which the Malays attach the miraculous power of curing all kinds of diseases, by means of the water in which it is dipped, and with which they imagine that the fortune of the family is connected.

The principal use of the diamond is in ornamental jewellery; it is also employed by glaziers to cut glass, and by lapidaries to engrave the harder gems; but for these purposes such only are used as cannot be cleaved in particular directions.

MINERAL CARBON.

Mineral Carbon is of a greyish black colour, and is destitute of bitumen: it consists of charcoal, with various proportions of earth and iron.

It has a glimmering, silky lustre, and a fibrous appearance, discovering a wood-like texture. It is somewhat heavier than common charcoal, and is easier reduced to ashes before the blowpipe, without either flame or smoke.

It occurs in thin layers, in brown coal, slate coal, slaty glance coal, and pitch coal; but in quantities too small to make separate use of.

PLUMBAGO. GRAPHITE.[*]

Plumbago is found in England, Scotland, France, Spain, Germany, and some other countries. Plumbago is of a dark iron black, passing into steel grey.

It occurs in mass, in kidney-shaped lumps, or disseminated, in rocks. It has a glistening metallic lustre, its fracture is granular and uneven; it is unctuous to the feel, soft, and not very brittle. When heated it does not flame, nor can it support combustion by itself. Its specific gravity somewhat exceeds 2.

Plumbago seems to belong exclusively to primitive countries; sometimes it enters into the composition of rocks; but is more usually found in detached masses, or in beds.

The principal use of plumbago is in the making of what are called *black-lead* pencils; for which purpose none has yet been discovered equal to that from Borrowdale in Cumberland, where it occurs in a considerable mountain of argillaceous schistus, traversed by veins of quartz;

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[*] A manufacture of black-lead pencils, exiſts in the city of New-York. Graphite with roſy quartz, was lately brought to me from Fiſhkill. Small quantities of it are not unfrequent. It is found in North Carolina, Pennſylvania, New-Jerſey, New-York, Connecticut, Rhode-Iſland, Maſſachuſetts, New-Hampſhire, and Maine. (*Cleaveland.*)

some account of the mine may be found in Parkes's 'Chemical Essays.' An inferior kind is met with in several places in France. It is also found in Bavaria, in Spain, and in Norway.

Whence this mineral obtained the name of *black-lead* it is difficult to say, unless it was from the lead-coloured streak which it gives upon paper. It has been ascertained that lead does not enter into its composition, but that the purest plumbago consists of about 90 parts of carbon and 10 of iron: an impure variety affords more of silex and alumine than of carbon or iron.

MINERAL OIL.*

Under this term are comprehended two substances, Naptha and Petroleum; both of which are liquid, highly inflammable, and lighter than water.

Naptha is nearly colourless and transparent; it burns with a blue flame, much smoke, gives out a penetrating odour, and leaves no residuum. It appears to be the only fluid in which oxygen does not exist in a considerable proportion; advantage has been taken of this circumstance by Sir H. Davy, who employed it, for that reason, in preserving the new metals discovered by him.

The most copious springs of naptha are on the coast of the Caspian sea in the peninsula of Apcheron; the surrounding country is calcareous, and the soil which affords the naptha is sandy and marly. It perpetually gives out vapours of a penetrating odour and very inflammable: it is said that the people of the country dress their food by means of it, for which purpose they pass it through earthen pipes. By distillation it yields naptha pure for medicine. The Persians employ the residuum to burn in their lamps instead of oil. A considerable revenue is derived from it by the Chief of the country.

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* Petroleum is found native in the weſtern diſtrict of New-York, where it is collected from the ſurface of certain waters, and ſold by the name of Seneka Oil. It is employed both inwardly and outwardly, as a remedy; and is extolled by the people, for its efficacy againſt diſeaſes, more eſpecially of the ſtomach, inteſtines, kidneys, ſkin, joints, &c. It is procured, too, in Ohio, and rated by many as a valuable medicine.

Naptha is also found in Calabria; on Mount Zibio near Modena; in Sicily, and in America, &c.; but it is supposed that travellers have sometimes mistaken petroleum for naptha.

In 1802, near the village of Amiano, in the state of Parma, a spring of naptha of a topaz yellow colour, was discovered, which readily burns without leaving any residue; it rises in sufficient quantity to light up the city of Genoa, for which purpose it is employed.

Petroleum, at the usual temperature, is rather thicker than common tar, has a strong disagreeable odour, and is of a blackish or reddish brown colour. It is *very* combustible, giving out during combustion a very thick black smoke, and leaving very little residue in the form of a black coal.

It is found in many countries, principally in those producing coal. At several places in France. In England, at Ormskirk in Lancashire, and at Coalbrookdale; occasionally in Cornwall and in Scotland. It occurs also in Bavaria, Switzerland, and in Italy near Parma. Near the latter place, the Petroleum gives out so powerful an odour, that the workmen cannot long endure it at the bottom of the Petroleum wells, without danger of fainting. It is found in many other parts of Europe and in America.

It is most plentifully found in Asia: round the town of Rainanghong in the Birman empire, there are 520 wells in full activity, into which petroleum flows from over coal. No water ever penetrates into these wells. The quantity of petroleum annually produced by them amounts to more than 400,000 hogsheads. To the inhabitants, its uses are important; from Moussoul to Bagdad it is used instead of oil for lamps; mixed with earth or ashes, it serves for fuel

When naptha is exposed to the air and light, it becomes brown, thickens, and seems to pass into petroleum: and when petroleum is distilled, an oil is obtained from it similar to naptha. When petroleum is exposed to the air, it thickens and passes into a kind of bitumen. Considerable alliance is thus proved to exist between Mineral Oil and Bitumen.

BITUMEN.[*]

The elementary constituents of Bitumen are carbon and hydrogen, occasionally nitrogen, and most probably some oxygen, which it is supposed, by its action on the other principles, and in proportion to its quantity, tends to form the harder Bitumens.

Bitumen is either *elastic* or *compact*.

Elastic bitumen is of various shades of brown. It has a slightly bituminous odour, and is about the weight of water. It burns readily with a large flame and much smoke, but melts by a gentle heat, and is thereby converted into a substance resembling petroleum, or maltha, or asphalt, according to its previous consistence.

Elastic bitumen takes up the traces of a pencil in the same manner as the Caoutchouc or India rubber, whence it has obtained the name of *Mineral Caoutchouc*.

Hitherto it has only been found in the Odin mine, near Castleton in Derbyshire, in a secondary limestone, accompanied by calcareous spar, fluor, blende, galena, pyrites, and asphalt. Elastic bitumen consists chiefly of bituminous oil, hydrogen gas, and charcoal; very small proportions of other substances have been detected by analysis.

Compact bitumen is of a brownish-black colour; one variety may be impressed with the nail, and is called maltha; another is very brittle, and is called asphalt.

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[*] The ancient bricks of Babylon, ſeveral of which I have had the beſt opportunities to examine, have a portion of bitumen adhering to them.—This is black, and emits by burning, a ſomewhat aromatic vapour. It appears to have loſt none of its peculiar qualities, during the term of perhaps 3000 or 4000 years, ſince it was firſt incorporated as a cement, in the walls and towers conſtructed by the ancient inhabitants of Shinaar. The ſpecimens I poſſeſs, of modern bitumen from Beſrah, or its vicinity, are ſubſtantially the ſame with that uſed of old. (*H. Austin.*)

Aſphaltum of St. Antonio, at the weſtern extremity of Cuba, is compact, deep black, and capable of ſupporting a flame, when heated and ſet on fire.

That from Trinidad iſland is not ſo pure; but is ſtated to be much more abundant.

Specimens from St. Stephens, near the Alabama river, were ſent me by Mr. Magoffin.

Maltha is brownish black and opake: it is tough, and soft enough to take an impression of the nail: it has a strong disagreeable odour, and is nearly twice as heavy as water. It consists of bitumen mixed with about 8 per cent. of carbon and a little earth.

Maltha is found in France, at a place called Puy de la Pège; where it renders the soil so viscous, that it adheres strongly to the foot of the traveller. It is also found in a mountain in Persia, between Schiraz and Bender-congo, where it is called baumemomie. It is collected with care, and sent to the King of Persia as being efficacious in the cure of wounds. It is occasionally used as a pitch, and in certain varnishes to preserve iron from rust; it is said to enter into the composition of black sealing wax.

Asphalt is brownish black; it occurs in mass, or disseminated, or stalactitic; it is opake, smooth and brittle, and somewhat unctuous to the touch, and gives out when rubbed a slightly bituminous odour. It is not so heavy as maltha.

By combustion, it leaves a small quantity of ashes. It consists chiefly of bituminous oil, hydrogen gas and charcoal, but the latter is in much greater proportion than in elastic bitumen; oxide of iron, and two or three of the earths, sometimes constitute very small proportions of it.

It is found in the Palatinate; in France; at Neufchatel in Switzerland; in large strata at Aolona in Albania; and in large pieces on the shores, or floating on the surface, of the Asphaltic lake in Judea, called the Dead Sea; which is said to have obtained the latter name from the belief that the Asphaltum caused the death of birds attempting to fly over it. It abounds in the islands of Barbadoes and Trinidad in the West Indies. In the latter it occurs in a vast stratum, three miles in circumference, called the Tar-lake; the thickness of which is unknown. A gentle heat renders it ductile, and when mixed with grease or common pitch, it is used for paying the bottoms of ships, and is supposed to protect them from that pest of the West Indian seas, the teredo or borer.

Asphalt is also employed as a varnish, and an essential part of the best wax, or varnish, for the use of engravers.

Both varieties of Bitumen, as well as the Mineral Oils, are unknown in primitive rocks, except in veins; they seem to belong exclusively to alluvial or primitive formations, in which they most commonly occur in calcareous, or clayey soils, or in the productions of volcanoes. They are said to be mostly found in the neighbourhood of salt formations. Some have conceived that the bitumens and mineral oils have originated in the destruction of the multitude of animals and vegetables found in the earth; of which we are every day discovering the remains.

The ancients employed bitumen in the construction of their buildings; and it is said that all historians agree that the bricks of which the walls of Babylon were built, were cemented with hot bitumen; which gave them very great solidity. Bitumen was carried down by the waters of a river which joined the Euphrates; it was also found in the salt springs in the neighbourhood of Babylon. The Egyptians are also said to have employed it for the embalming of bodies; constituting what we now call mummies.

Bitumen enters into the composition of the black indurated marl or shale which accompanies common coal; and which is generally mixed with it in variable proportions. It is likewise found in certain limestones; for instance that of Aberthaw, of which bitumen forms about 2 per cent.

COAL.

The bituminous substance called coal, though ranked among minerals because its basis is pure carbon, is now by many believed to be of vegetable origin, because the substance which lies upon the coal, is always filled with vegetable remains; as well as because a wood-like appearance may be traced through every species of coal, even the most compact.

Mineralogists are not agreed in their arrangement of this important genus of mineral inflammables.

Coal may be divided into four species : brown coal, black coal, cannel coal, and glance coal.

Brown Coal is imperfectly bituminous, of a brown colour, and of a vegetable texture. It may be divided into three varieties : Bituminized wood, Earthy Brown Coal, Compact Brown Coal, and Moor Coal.

Bituminized wood is of a dark brown colour. Its external shape exactly resembles that of compressed trunks and branches of trees ; its internal texture is precisely that of wood, retaining not unfrequently that of the bark. It is opake, soft, somewhat flexible, and almost light enough to float upon water. It burns with a clear flame, though with but little heat, and gives out a *bituminous* odour, often mixed with that of sulphur.

The surturbrand of Iceland contains 58 per cent. of watery and volatile inflammable matter, leaving 42 per cent. of carbonaceous and earthy residue.

Bituminized wood occurs in alluvial land among beds of compact brown coal; sometimes also forming beds of itself. It is also met with in dispersed fragments in alluvial soil. It abounds in the newest flœtz-trap formation, and forms masses in limestone and sandstone belonging to the independent coal formation. In the Prussian amber mines, it forms the stratum immediately above the amber, and nodules and stalactites of this beautiful substance are generally found intermixed with it.

Earthy Brown Coal is blackish or wood brown, or yellowish grey ; it occurs in mass, of a consistence between solid and friable ; it is without lustre ; soils the fingers a little ; it is very soft, falls easily to pieces, and it is a little heavier than water.

It readily takes fire, and burns with a weak flame and disagreeable bituminous odour. It contains 15 to 20 per cent. of earth and oxide of iron, the remainder being water and inflammable matter. It often contains pyrites, and then passes into alum earth.

It is found in similar situations with bituminized wood : in the neighbourhood of Leipsig it occurs in beds from 20 to 40 feet thick, and of great extent.

It is used as an inferior kind of fuel, when little heat is required ; for which purpose it is moistened with water, well beaten, and made into masses like bricks. In the vicinity of Cologne, a variety is found of a rich reddish brown colour, which is prepared as a pigment under the name of *Cologne umber*, which is employed as a colour both in distemper and oil painting. It is also found in Hesse, Bohemia, Saxony, and Iceland. The Dutch are said to employ it in the adulteration of snuff, to which it imparts, when used in certain proportion, a peculiar softness.

Compact Brown Coal, is of a blackish brown colour. It occurs in mass; its fracture is fibrous lamellar; its cross fracture somewhat conchoidal; it has a resinous lustre, and is moderately hard. Its specific gravity is about 4.5.

It burns readily with a weak flame, and a disagreeble odour; by combustion, it leaves a small quantity of white ashes: 200 grains yield by distillation, 90 of charcoal, 60 of acidulous water, 21 of thick, brown, oily bitumen, and 29 of hydrogen, carburetted hydrogen, and carbonic acid.

In England, it is found at Bovey near Exeter, and is called Bovey coal: at this place there are 17 strata within the depth of 74 feet from the surface, alternating with alluvial clay; the greatest thickness of the seams or beds is between 6 and 8 feet. Brown coal is also found in various parts of the territory of Hesse, and in other parts of Germany; also in Denmark, Greenland, and Italy.

It is used for fuel: it passes into bituminous wood and moor coal, and sometimes into pitch coal.

Moor coal is of a darkish brown colour. It occurs in mass, forming very thick beds, and is always full of crevices. Internally it displays a considerably resinous lustre. Its longitudinal fracture is somewhat slaty; its cross fracture approaches to conchoidal; its fragments are trapezoidal or rhomboidal. In its chemical characters it resembles the preceding variety of Brown coal.

It occurs in alluvial land, and in the newest flœtz-trap formation. It is met with very frequently in Bohemia; it is also found in Transylvania, and other parts of the Austrian dominions; also in Denmark, and the Ferroe islands.

Black Coal, the **Slate Coal** of **Mineralogists**, is perfectly bituminous; it may be said to comprehend all the varieties of common coal used for economical purposes. It may generally be said to be of a black colour, having an irridescent tarnish, and a high resinous lustre. It is composed of about 60 parts of carbon, and 36 of maltha and asphalt, and from 3 to 6 per cent. of earth and oxide of iron.

Slate coal is found principally in the independent coal formation, and is the most widely diffused of any of the species. It is often mixed with pyrites, and penetrated by thin veins of quartz or calcareous spar. It always occurs in nearly horizontal strata, which are abundant in Durham, Northumberland, Yorkshire, and in some other parts of England, and in several parts of Europe.

The two points which are principally to be attended to with regard to common coal, in an economical point of view, are the intensity of heat and the duration of combustion, and these are chiefly influenced by the proportion of asphalt contained in the coal. That in which the bituminous part is chiefly maltha, with only a small quantity of asphalt, kindles very easily, burns briskly and quickly with a bright blaze, cakes but little, requires no stirring, and by a single combustion is reduced to loose ashes; such are the varieties of coal from Lancashire, Scotland, and most of those which are raised on the western side of England.

Those on the other hand, in which asphalt prevails, kindle difficultly, and after lying some time on the fire, become soft, and almost in a state of semifusion; they then cohere and cake, swell considerably, and throw out on every side tubercular scoriæ, accompanied by bright jets of flame. In consequence of the cohesion and tumefaction of the coals, the passage of the air is interrupted, the fire burns hollow, and would be extinguished if the top were not broken in from time to time. The produce of ashes is smaller than in the free burning coals; the greater part of them being mixed in the carbonaceous part of the coal and forming grey scoriæ, commonly known by the name of cinders, which being burnt again with fresh fuel, give out an intense heat, and are slowly reduced, partly to heavy ashes, partly to slag. The best coal of Northumberland, Durham, and Yorkshire, is of this kind; it burns slower, and gives out more heat than the preceding, and in general bears a higher price.

Cannel Coal or *Candle Coal*, is of a greyish black colour, and has a glistening resinous lustre. Its fracture is conchoidal. It is brittle, but is the most difficultly frangible of all the coals, and is somewhat heavier than jet. It is very inflammable, and burns quickly, but does not cake, and leaves behind 3 or 4 per cent of ashes.

It occurs in the independent coal formation. It is found in great plenty and remarkably pure, at Wigan in Lancashire, and occasionally in most other English collieries.

Its chief use is as fuel, but the purest from Wigan may be worked in the turning lathe, from which it receives a high polish; hence it is shaped into various ornamental utensils; and when cut into beads, is not to be distinguished from jet.

The *Splent* Coal, which abounds at Glimerton, near Edinburgh, is considered to be an inferior variety of cannel coal.

Glance Coal. Of this there are three varieties, the conchoidal, the columnar, and the slaty.

Conchoidal Glance Coal is iron black; it occurs in mass, with a bright shining metallic lustre and a perfectly conchoidal fracture. It is moderately hard, frangible, and light.

It burns without flame or smell, and leaves a white ash. It is of rare occurrence, having been met with only at Newcastle and in the Meissner at Hesse. That from the latter place has been analyzed, and contains nearly 97 of charcoal, 2 of alumine, and 1 of oxide of iron.

Columnar Glance Coal is of a dark greyish black; it occurs in mass and possesses a shining lustre, between resinous and metallic. Its fracture is not perfectly conchoidal; is very soft, frangible, and light, and always occurs in thick, curved, parallel, columnar, distinct concretions, having smooth glimmering surfaces.

It burns without flame or smell, leaving a greyish white ash. It has hitherto only been found at the Meissner in

Hesse, where it occurs, together with other coal, in the newest flœtz-trap formation.

Slaty Glance Coal, *Anthracite*, *Kilkenny Coal*, or *Welch Culm*, is a dark iron black colour, verging on steel grey; it occurs in mass; has a bright metallic lustre; its fracture is somewhat slaty and curved in one direction, and somewhat conchoidal in the other; it breaks easily, and is but little heavier than water.

When pulverized and heated, it becomes red and slowly consumes with a very light lambent flame, without smoke, and when pure emits no sulphureous or bituminous odour; it leaves a variable proportion of reddish ashes.

The Kilkenny coal is somewhat harder than is customary with this variety.

Slaty Glance coal consists of carbon, with from 3 to 30 per cent. of earth and iron.

This mineral occurs in imbedded masses, beds, or veins, in primitive, transition, and flœtz rocks. It is found in gneiss, in micaceous schistus, in mineral veins, with calcareous spar, native silver, mineral pitch, and red iron ore; and has been discovered by Jameson in the independent coal formation in the isle of Arran.

JET. PITCH COAL.*

Jet is generally of a velvet black; it occurs in mass, and sometimes in the shapes of branches, with a regular woody structure. It has a brilliant, resinous lustre, and a perfectly conchoidal fracture; it is soft and brittle, and is but little heavier than water.

It burns with a greenish flame and a strong bitu-

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* Coal is ſaid to exiſt abundantly near Cape Breton, and in the N. E. part of Nova Scotia.

The coal of Rhode-Iſland is mingled with quartz, and occaſionally with fibrous aſbeſtos. Yet it has but little hydrogen, and leſs bitumen. It is overlaid by coarſe ſhale, containing numerous and ſtrong impreſſions of ferns.

The indications of coal along Connecticut river, have raiſed high expectations, even in the minds of miners and geologiſts. But the digging, boring and ſearching, have not hitherto diſcloſed any thing very conſiderable. The ſmall ſamples I have ſeen, abound in bitumen, and ſeem to be ſufficiently inflammable. It has been ſuppoſed that the bituminous

minous smell, leaving a yellowish ash. It occurs principally in marly, schistose, calcareous, or sandy beds.

It is met with in several places in France: where it is sometimes found enclosing amber. In one place it occurs in oblique beds, at a considerable depth, between beds of sandstone. It is likewise found near Wettemberg in Saxony, and in several places in Spain. It occurs in the Prussian amber mines in detached fragments, and is there called black amber.

In France, Germany, and Spain, it is worked into various trinkets, chiefly worn as part of the mourning habit; but when not sufficiently fine and hard for that purpose, it is used as fuel.

AMBER.*

Is a mineral of a yellow or reddish brown, or of a greenish or yellowish white colour. It is found in no-

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ſchiſtus which contains the figures of fiſhes, overlays coal; and the conjecture carries great weight.

The coal around New-York, as on Long-Iſland and Staten-Iſland, for example, conſiſts moſtly of carbonized or vitriolated wood. The ſpecimens of coal from the neighbourhood of Newark, Middletown, and ſome other places, though they afford indications of bitumen, are too ſcanty to be of any economical uſe.

In Pennſylvania, there are two great coal formations; one ſituated S.E. of the mountains, and the other N.W. The former is the glance coal, extending almoſt from Delaware along the head waters of the Lehigh and Schuylkill, and to Wilkeſbarre on the Suſquehannah, and along the Juniata. The latter abounds at Pittſburgh, and in the adjoining lands along the Alleghany and Monongahela rivers, as well as extenſively on both ſides of the Ohio. (*Darby.*)

A conſiderable body of coal exiſts on the ſouth ſide of James river, in Virginia. This is extenſively in uſe for fuel, and tranſported to diſtant places, coaſtwiſe. It reſts upon a primitive bottom, and is overlaid by ſhale, containing vegetable impreſſions. (*Maclure.*)

* Amber has been found near Croſwick's Creek, a few miles from Trenton. There are two varieties, the white and the yellow. Of the latter, I have a ſpecimen from General Wilſon, about two inches long, and an inch broad; a part of a larger maſs. It has a granular or cryſtalline conſtitution internally; and appears externally, as if it had been moulded or figured by the contact of wood. There are *fragments of ſhells* connected with it. Theſe are probably marine, as a belemnite was brought along, the better to ſhow the locality. This amber lies in the alluvial ſoil, reſting upon carbonated wood, ſcattered in grains through ſhell-marl, and mingled with decompoſing pyrites. Though after friction it readily attracts light ſubſtances, it is not fine and tranſparent enough for ornamental purpoſes.

dules or rounded masses, from the size of coarse sand to that of a man's head.

It is sometimes transparent, always translucent, and occasionally encloses insects of the ant species, in remarkable preservation. It is somewhat heavier than water. The strong electric powers of amber are generally known. This property gave rise to the science of electricity, which was so called from Ηλεκτρον (Electron) the Greek name for amber. It seems to belong exclusively to countries of late formation.

In Greenland, Kamschatka, and Moravia, it is found in grains disseminated through coal. It also occurs on the shores of the Baltic, of Sicily, and of the Adriatic sea; in Poland, France, Italy, and many other countries; and occasionally in the beds of gravel in the neighbourhood of London, and on the coast of Norfolk and of Suffolk. Near the sea coast in Prussia, there are regular mines of amber: under a stratum of sand and clay about 20 feet thick, succeeds a stratum of trees 40 or 50 feet thick, half decomposed, impregnated with pyrites and bitumen, and of a blackish brown colour.—— Parts of these trees are impregnated with amber, which sometimes is found in stalactites depending from them. Under the stratum of trees were found pyrites, sulphate of iron and coarse sand, in which were rounded masses of amber. The mine is worked to the depth of 100 feet, and from the circumstances in which the amber is found, it seems plain that it originates from vegetable juices.

The real nature and origin of amber are not understood: it is generally considered to be a fossil resin, somewhat mineralized. It yields by distillation an acid, called the *succinic acid*, (succinum being the Latin for amber) and leaves as the residue, an extremely black, shining coal, which is employed as the basis of the finest black varnishes. When exposed to flame in the open air, amber takes fire and burns with a yellowish flame, giving out a dense, pungent, aromatic smoke, and leaving a light, shining, black coal.

MELLITE. HONEYSTONE.

The Mellite is a rare mineral, having hitherto only been found in Thuringia, in the district of Saal, and in Switzerland. It occurs on bituminous wood, and earthy coal, and is generally accompanied by sulphur. In Switzerland it is accompanied by asphaltum.

The honeystone is softer than amber, is transparent, brittle, and electric; possesses a double refraction, and is found crystallized in the octohedron.

When burnt in the open air, neither smoke nor flame are observable, and it eventually acquires the colour and consistence of chalk. The Mellite is composed of 84 parts of mellitic acid, about 14 of alumine, 2 of silex, and some iron. Its composition differs essentially from that of every other combustible mineral.

RETINASPHALT.

Retinasphalt has been found at Bovey Tracey in Devonshire, adhering to brown coal in the form of irregular opake lumps of a pale brownish yellow colour, with a glistening lustre and imperfect conchoidal fracture. It is very brittle and soft, and somewhat heavier than water. When placed on a hot iron, it melts, smokes, and burns with a bright flame, giving out a fragrant odour; it consists of 55 parts of resin, 42 of asphalt, and 3 of earth.

FOSSIL COPAL.* HIGHGATE RESIN.

Fossil Copal or Highgate Resin was found in considerable quantity in the bed of blue clay of which

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* I have received Foſſil Copal from Jucatan, whence it is ſometimes brought to New-York. The maſſes are as large occaſionally as a man's fiſt, of a yellowiſh tranſparency and a reſinous fracture. It is uſually dug out of the ground, and ſeems occaſionally to be waſhed from the upland into the ſea; for navigators have obſerved copal to be raiſed from the bottom, with the mud that adheres to their anchors.

Highgate Hill near London, in great measure consists. It is in irregular roundish pieces of a light yellowish dirty brown colour, sometimes transparent and with a resinous lustre; it is brittle, yields easily to the knife, and is but little heavier than water. It gives out a resinous aromatic odour when heated, and melts into a limpid fluid; when applied to the flame of a candle it takes fire, and before the blow-pipe burns away entirely.

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